SHIFTING SANDS AND GEOPHYTES: GEOARCHEOLOGICAL INVESTIGATIONS AT PALUXY SITES ON FORT HOOD, TEXAS

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United States Army Fort Hood
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To mitigate damage to National Register-eligible archeological sites from cedar clearing and firebreak blading at Fort Hood, the Cultural Resources Management Program initiated a Paluxy site testing and data recovery project in the summer and fall of 2000. Intensive testing was done at three Paluxy sites—41CV595, 41CV988, and 41CV1141—to determine the extent of damage and whether intact buried deposits remained. Results indicate that 41CV988 is no longer eligible for listing in the National Register of Historic Places, but the other two sites still retain significant archeological deposits. Named the Firebreak site, 41CV595 was selected for partial data recovery. Investigations of three separate areas recovered 3,394 artifacts and exposed 16 features. Data indicate that Firebreak was occupied intermittently from around 1000 B.C. to as late as A.D. 1300–1500. Although tool assemblages indicate hunting and animal processing, distinctive burned rock features suggest plant processing was the primary subsistence activity. It is likely that Paluxy occupations at Fort Hood represent specialized plant processing during the spring and fall. Regional comparisons suggest that archeologists are underestimating the economic importance of geophytes as major subsistence resources for the prehistoric inhabitants of central Texas.

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ABSTRACT

To mitigate damage to National Register-eligible archeological sites from cedar clearing and firebreak blading at Fort Hood, the Cultural Resources Management Program initiated a Paluxy site testing and data recovery project in the summer and fall of 2000. Intensive testing was done at three Paluxy sites—41CV595, 41CV988, and 41CV1141—to determine the extent of damage and whether intact buried deposits remained. Results indicate that 41CV988 is no longer eligible for listing in the National Register of Historic Places, but the other two sites were found to still retain significant archeological deposits. Herein named the Firebreak site, 41CV595 was selected for partial data recovery, and hand excavations totaled 35.7 m^3 (67 m^2). Investigations of three separate areas recovered 3,394 artifacts and exposed 16 features. Temporally diagnostic dart and arrow points and 15 radiocarbon dates indicate that the Firebreak site was occupied intermittently from around 1000 B.C. to as late as A.D. 1300–1500. Although tool assemblages indicate hunting and animal processing, distinctive burned rock features–mounds, middens, and earth oven cooking pits–suggest plant processing was the primary subsistence activity. Recovery of charred bulb fragments of eastern camas or wild hyacinth (*Camassia scilloides*) and wild onion (*Allium canadense*) indicates that the earth oven technology was used for cooking the underground roots of selected geophytes (plants with enlarged underground storage roots). Oak acorn and pecan shell fragments represent other important foods. It is likely that the Firebreak site and other Paluxy occupations at Fort Hood represent specialized plant processing activities during the spring and fall. Regional comparisons suggest that archeologists are underestimating the economic importance of geophytes as major subsistence resources for the prehistoric inhabitants of central Texas.

ACKNOWLEDGMENTS

First and foremost, thanks go to everyone at the Fort Hood Cultural Resource Management Program under the direction of Dr. Cheryl Huckerby. The Paluxy site project that led to this research report continues the long-term cultural resource management work at Fort Hood that began in 1977. The Paluxy site project was initiated in August of 1999, and the excavations at the Firebreak site (41CV595) reported herein represent the first major archeological data recovery work on Fort Hood (along with the concurrent data recovery at the Clear Creek Golf Course site by TRC Mariah Associates, Inc.). Huckerby and the cultural resources staff at Fort Hood are to be commended for their support of the Paluxy site project and data recovery work at the Firebreak site. Special thanks go to Karl Kleinbach, whose thoughtful comments during repeated site visits and later analysis helped us better understand the Firebreak site.

As has been the case since 1995, Prewitt and Associates, Inc. (PAI), depended on the folks at Training Area Access and G3 Range Control, especially Larry Ximenez at G3, for coordinating field work schedules and logistics. The Department of Public Works provided mechanical excavation equipment and operators. Larry Polman coordinated the scheduling of machines and operators. Lester Duncan operated the backhoe, and Bill Grigsby operated the Gradall.

PAI personnel for this project were Doug Boyd (principal investigator), Gemma Mehalchick (project archeologist), Chris Ringstaff (lithic analyst), Karl Kibler and Amy Holmes (project geomorphologists), and Karen Gardner (collections manager). Field crew members were Dennis Glinn, Mark Holderby, Chris Ringstaff, Janée Taylor, and Mike Wilder. Fort Hood archeologists Kleinbach and Kristen Wenzel also helped excavate at the Firebreak site.

This report is a collaborative effort by many people besides the authors. Boyd and Jane Sevier edited the report, and Sandy Hannum and Brian Wootan drafted the figures. Jack Rehm photographed the artifacts. Karen Gardner managed the artifact database management and identified freshwater mussel shells. Consultants who contributed special studies to this report are Brian Shaffer (faunal analysis), Mary Malainey and Kris Malisza (organic residue analysis), and Phil Dering (macrobotanical analysis). Beta Analytic, Inc., did the radiocarbon assays.

Several of the Fort Hood CRM staff–Huckerby, Kleinbach, and Kristen Wenzel–and Ed Baker (Archeology Division of the Texas Historical Commission), Steve Tomka (Center for Archaeological Research, University of Texas at San Antonio), and Mike Quigg (TRC Mariah Associates, Inc.) reviewed this report. Thoughtful peer review comments from all of them helped make this a better report. Special thanks go to Steve Black and Mike Quigg, who visited our excavations at Firebreak and provided sound advice on burned rock features, organic residue studies, and other esoteric topics. Laura Sanchez, Fort Hood senior botanist, also deserves special recognition for her assistance in helping us interpret plant use by prehistoric peoples in central Texas.

Gemma Mehalchick

Project Archeologist

INTRODUCTION

Douglas K. Boyd and Gemma Mehalchick

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This report documents the geoarcheological investigations at three sites on Fort Hood that contain cultural remains buried within concentrations of sandy sediment derived from the Paluxy Formation. All three of these sites had been tested previously, but further testing was done in response to the loss of important archeological data from machine clearing of vegetation. This round of testing was followed by partial data recovery at 41CV595, herein named the Firebreak site. The Firebreak site and all other sites found within the same sandy sediments on Fort Hood are now referred to as Paluxy sites.

Based on archeological research over the past decade, Paluxy sites are recognized as being in a unique geologic and topographic setting within the installation. The sandy outcrops are limited in horizontal extent, but they fall within an intermediate upland area characterized by exposed limestone hills and slopes. As such, sand exposures adjoining Paluxy outcrops were attractive camping locations to the prehistoric peoples in this upland setting within this portion of central Texas. Archeologically, the Paluxy environment offers an opportunity to examine prehistoric human activities in a part of the landscape that is very different from all others on Fort Hood, and Paluxy sites represent a type of open campsite distinct from all those in other upland and alluvial settings.

SHIFTING SANDS AND GEOPHYTES

The Cretaceous Paluxy Formation is present in subsurface over an extensive portion of central, north central, and northeast Texas, encompassing part or all of 50 counties. Friable fine- to very fine-grained quartz sand dominates the Paluxy Formation, and discontinuous outcrops of these sandy beds are found along the western edge of the formation. The southeast margins of these discontinuous outcrops occur on the west side of the Fort Hood military reservation in Coryell County (Figure 1.1). All of these outcrops appear between the elevations of 250 and 300 m above sea level immediately below the sloping Killeen surface and at its contact with the upper margins of the incised stream valleys. The Paluxy outcrops on Fort Hood are relatively small and difficult to map precisely (see Kibler 1999 for detailed discussion of Paluxy Formation on Fort Hood). The 1:250,000 Waco Sheet of the *Geologic Atlas of Texas* (Proctor et al. 1970) shows only a small outcrop, about 500 acres, within the reservation boundary. A much more realistic indicator is the distribution of Cisco and Wise soils, which cover about 1,800 acres on Fort Hood (McCaleb 1985). Accounting for less than 1 percent of the total area of the fort, the distribution of these sandy soils approximates the true extent of Paluxy Formation outcrops (Figure 1.2) in western Fort Hood (Abbott 1994:Figure 9.10).

Previous investigators recognized that outcrops of sandy Paluxy sediments occupy a distinct geomorphic and environmental niche on the installation and that prehistoric cultural remains are commonly buried in these settings (Abbott and Trierweiler, ed. 1995a; Kleinbach et al. 1999; Mehalchick et al. 2000; Trierweiler, ed. 1994, 1996). These observations led researchers to speculate that prehistoric people intentionally selected the isolated Paluxy sand outcrops as favorite camping spots, probably to exploit some abundant plant resource (a single plant or group of plants) that was clustered in the vicinity.

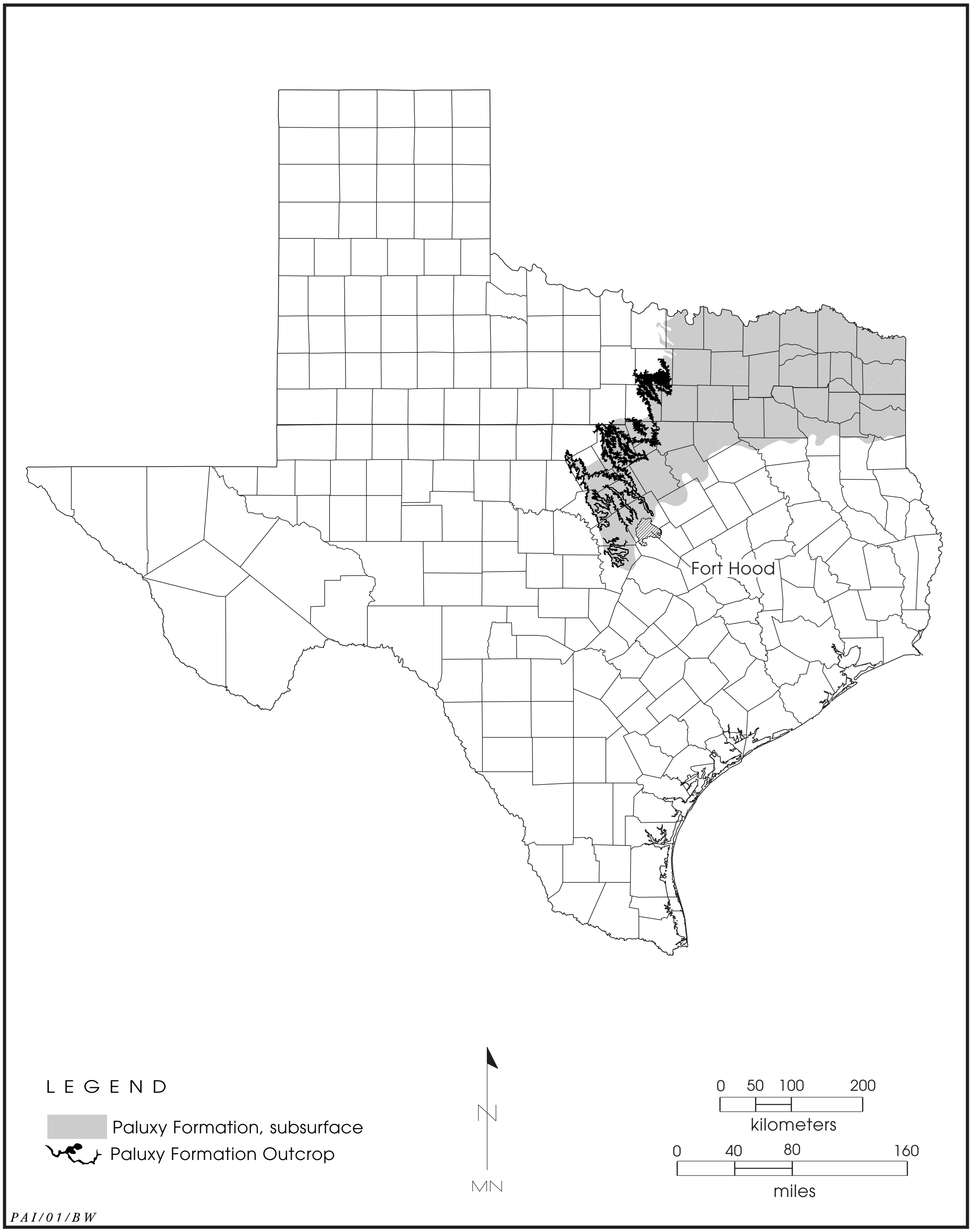

Figure 1.1. Extent of the Paluxy Formation.

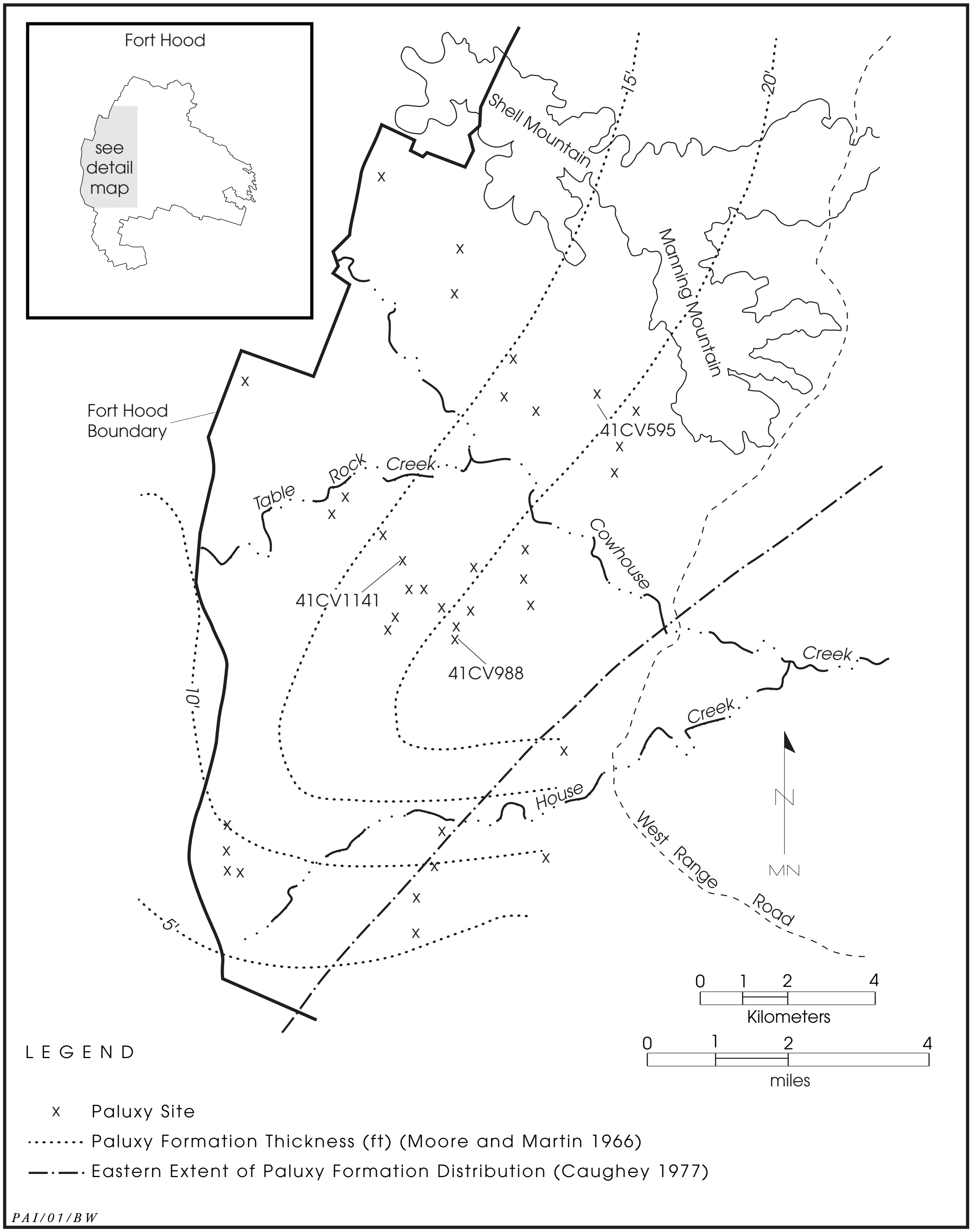

Figure 1.2. Distribution of the Paluxy Formation and Paluxy sites on Fort Hood.

One of the goals of the work at Firebreak was to look for evidence of plant exploitation. In many ways, Firebreak is typical of central Texas prehistoric sites that are dominated by burned rocks and rather unimpressive chipped stone artifacts. As with many such sites, it was the burned rock features found at the site that provided the most important evidence of past human activities. Recovery of charred fragments of geophyte bulbs (of wild hyacinth and wild onion) from earth oven cooking pits at Firebreak is particularly significant.

A geophyte is defined as "a perennial plant, such as a tulip, propagated by buds on underground bulbs, tubers, or corms" (*American Heritage College Dictionary*, Third Edition, 1993, Houghton Mifflin Company, Boston). The underground sections of these plants are essentially food storage organs that amass nutrients during the growing season to feed the plant during the winter. Geophyte food storage organs can be classified as bulbs, corms, rhizomes, taproots, or tubers (definitions by Thoms [1989:Table 2] are presented in Chapter 8).

The geophyte bulbs found at the Firebreak site are eastern camas and wild onion, both in the lily family. Finding these bulbs at Firebreak—as well as similar finds of various lily bulbs at many other archeological sites in central Texas in recent years—is an important milestone in the attempt to reconstruct prehistoric hunter-gatherer life. Although the use of limestone rocks as heating elements within earth ovens is well documented in Texas (e.g., Black et al. 1997; Hester 1991), archeologists are only now beginning to understand just how important bulk processing geophytes was to human subsistence within the Edwards Plateau region. The role of geophytes in the prehistory of central Texas is discussed in more detail in Chapters 8 and 9.

The pivotal subsistence role of geophytes for the historic Native Americans in the Pacific Northwest is well documented ethnographically and extended back into prehistoric times (e.g., Hunn and French 1981; Thoms 1989). Unfortunately, the early historic period ethnographic data on Native Americans in central Texas do not compare to those of the Pacific Northwest. Most of the Native Americans in central Texas during the contact period were late comers and had already undergone radical changes in lifestyle before Europeans or Anglo Americans encountered them. Without a significant body of ethnographic data and a means to link it back to prehistoric peoples, only the archeological remains can tell the story of prehistoric hunter-gatherer life. There is a growing body of evidence, however, that suggests that geophytes were probably every bit as important to the prehistoric hunter-gatherers in the Edwards Plateau region as they were to the Native Americans in the Pacific Northwest.

PROJECT HISTORY

Cultural resource investigations on Fort Hood began in 1977. Archeological survey and site inventory projects spanned all of the 1980s, and this focus was followed by a decade of systematic testing and evaluation of prehistoric sites. The inventory of prehistoric sites is virtually complete (except for some portions of the live fire range), and most of the known sites have now been evaluated (for a more complete history of previous archeological research on Fort Hood, see Ellis et al. [1994:21–25], Mehalchick et al. [1999:18–21], and Trierweiler [1996:33–36]). The Paluxy testing and data recovery project described in this report was initiated in 1999, but the history of Paluxy research goes back years earlier. Mariah Associates, Inc., archeologists first recognized Paluxy sites on Fort Hood between 1991 and 1993 during reconnaissance and shovel testing of 571 sites on Fort Hood (Trierweiler 1994). Abbott (1995c:327) noted that:

> Although it was not considered prior to initiation of field work, the Paluxy emerged as an area of interest gradually throughout the reconnaissance process. Probably the first broad, informal observations made by the reconnaissance team were utilitarian: (1) significant slopewash activity was typically demonstrable in the environment, resulting in a surface mantle that required shovel testing, and (2) shovel tests in the Paluxy were much easier to dig than in most other environments on the fort, which generally made the crew happy. Gradually, however, relatively consistent archeological observations from site to site led us to add the phrase "Paluxy site" to the field lexicon.

The important observations were that outcrops of Paluxy sand were likely to contain archeological remains although immediately surrounding remains did not. The link between reddish sand outcrops and cultural deposits was strong and represented intentional human selection of these localities.

During these early investigations, Paluxy sands were found only in the western portion of the fort and are discontinuous. Abbott (1994:329) stated that, "Although the broad stratigraphic context limits its distribution to the contact between the Walnut clay and the Glen Rose Limestone, our observations indicate that the Paluxy sands form a thin, spotty mantle on the upper Glen Rose rather than a continuous outcrop." The initial reconnaissance study by Mariah archeologists examined "43 site management areas either partially or wholly underlain by the Paluxy substrate" and concluded that "the Paluxy substrate was being preferentially selected by the prehistoric inhabitants."

All later testing of Paluxy sites by Mariah Associates (Abbott and Trierweiler 1995a; Trierweiler 1996) and Prewitt and Associates (Kleinbach et al. 1999) has reinforced this idea and leads to one obvious conclusion: Paluxy sand outcrops do constitute a unique environment that prehistoric peoples selected intentionally and used intensively. Since the early 1990s, researchers have debated what characteristics made the Paluxy environment attractive to prehistoric peoples. The proposed ideas fall essentially into three groups—Paluxy localities were selected because some particular biotic resources were "unique to or concentrated on Paluxy soils;" the sandy soils were well drained and constituted a "desirable living surface;" and the sandy texture made it easier to excavate cooking pits in a landscape dominated by limestone and dense clay soils (Abbott 1995c:816–817). Transformation of these ideas into specific hypotheses and a research design for Paluxy sites are discussed later (see Chapter 3), but the basic concept of a unique Paluxy environment holds true. This report documents the first serious attempt that goes beyond management-oriented testing and site evaluation to look at why people came to occupy a Paluxy site and what they were doing while they were there.

To date, 37 Paluxy sites on the installation have been investigated and evaluated for National Register of Historic Places (National Register) eligibility. The geomorphic and archeological evidence indicates intensive use of this environment from the Late Archaic period through Protohistoric times. Intact burned rock features, charred macrobotanical remains, and artifact assemblages consisting primarily of chipped stone tools and debris hint at the activities represented.

But these sites are easily damaged because the cultural remains are shallowly buried, usually in the upper meter, in loosely consolidated sandy sediments. Once the surface and vegetation cover are disturbed at any location, these sediments tend to erode rapidly. As of August 1999, 13 (72 percent) of the 18 National Register-eligible Paluxy sites on Fort Hood had been disturbed by a variety of activities, including emergency firebreak construction, juniper ("cedar") clearing, and military training maneuvers, particularly vehicular (tank) traffic (Abbott and Trierweiler 1995a:674–675; Huckerby 1998a, 1998b; Kleinbach 1999; Kleinbach et al. 1999:426). By January 2000, the number of eligible sites had increased to 19, but none had escaped some type of damage (Boyd et al. 2000:37–38). One more site was tested and recommended eligible in 2002, and it, too, had been damaged by cedar clearing (Mehalchick and Kibler 2002:77–83). Adding this site brought the number of National Register-eligible sites to 20, and all of them had been disturbed to some degree. Because they are disturbed so frequently and easily, Paluxy sites are a threatened resource on Fort Hood (see Abbott and Trierweiler 1995:674–675; Boyd et al. 2000:37–38).

Damage to 41CV595 and other sites from training, firebreak work, and cedar clearing is mitigated by this detailed project to assess the composition of Paluxy sites and their role in central Texas prehistory (Huckerby 1998a, 1998b, 2000; Kleinbach 1999).

The Paluxy testing and data recovery project described in this report was initiated in 1999 under the direction of Kimball Smith, in response to recommendations Kleinbach (1999:4) made. The project was carried out specifically to mitigate damage to Paluxy sites from cedar clearing and other ground disturbing activities. Three moderately to severely disturbed sites—41CV595, 41CV988, and 41CV1141—were chosen for further testing and reassessment. One site, 41CV595, had been damaged by firebreak blading during a 1996 range fire (Huckerby

1998b), and the other two sites were damaged by cedar clearing activities in 1997–1998 (Kleinbach 1999). Prewitt and Associates, Inc. (PAI), conducted the mechanical and manual test excavations at these three Paluxy sites between 19 July and 15 August 2000. Five Gradall trenches, 21 backhoe trenches, and 32 test units (all but 2 measured 1x1 m) were excavated during this testing phase. Each site was then reevaluated for its potential for listing in the National Register. Sites 41CV595 and 41CV1141 are still recommended as eligible for listing in the National Register, but 41CV988 is recommended as ineligible.

The second phase of the Paluxy project then began. In consultation with new Fort Hood Contracting Officer's Technical Representative Dr. Cheryl Huckerby, one of the three sites—41CV595—was chosen for partial data recovery, and the fieldwork was conducted from 17 August to 26 September 2000. All of this archeological work for this Paluxy project—further testing and partial data recovery—was conducted in partial fulfillment of Fort Hood's obligations under the National Historic Preservation Act of 1966 (PL 89–655), the Archeological and Historical Preservation Act of 1974 (PL 93-29), the National Environmental Policy Act of 1969 (PL 91-190), Executive Order Number 11593, and the Programmatic Agreement among the United States Army, the Advisory Council on Historic Preservation, and the State Historic Preservation Officer. This final report was preceded by two draft versions, one dated August 2002, and the second dated July 2003.

Data recovery at the Firebreak site was partial in the sense that it was intended to mitigate some of the destruction of important archeological remains that had occurred at this and other Paluxy sites. It was not intended to constitute total mitigation of the intact cultural deposits at the Firebreak site so the entire site could be determined ineligible and written off for management purposes. The work involved manual excavation of 57 more test units, bringing the total for testing and data recovery at the site to 67 units (35.67 m^3).

Contiguous units were excavated to sample the cultural deposits in three separate areas—designated as Areas 1 to 3—with high archeological research potential, but the data recovery focused primarily on two of these areas. Hand excavations in Area 1 consisted of only 3 test units (3.20 m^3). Although the sediments were up to 1.1 m thick, the only isolable component consisted of a hearth remnant near the base of the deposit. The most intensive work was concentrated in Area 2, where an excavation block was composed of 45 contiguous test units (20.49 m^3). Here, the cultural deposits averaged almost 50 cm thick and contained multiple burned rock features, including a cooking pit that yielded charred bulb fragments and an associated stone artifact assemblage.

In Area 3, 19 test units (11.98 m^3) were placed on and just west of a burned rock mound; 9 of these units were located around an internal pit feature encountered near the center of the mound. The artifacts, features, and chronological data indicate the Firebreak site was used repeatedly for approximately 2,000 years, primarily during the Late Archaic period through the Austin phase.

REPORT ORGANIZATION

This report consists of nine chapters and four appendices. Chapter 2 presents environmental background, and Chapter 3 provides archeological background and research contexts. Field, laboratory, and analytical methods are reported in Chapter 4. Chapters 5 and 6 detail investigations undertaken at 41CV988 and 41CV1141. These two chapters describe all of the past and present work accomplished, summarize the findings, and analyze and interpret the geoarcheological data at these sites.

Chapter 7 divides the Firebreak site into the three separate areas where excavations were conducted to present the results of the investigations. In Chapter 8, more detailed analyses examine chronology, site formation processes, spatial relationships of cultural features and materials, lithic procurement and reduction strategies, subsistence technologies and resources, site function, and seasonal use. Archeological evidence from the Firebreak site also is viewed in relation to other Paluxy sites on Fort Hood and other sites in central Texas. Chapter 9 concludes with site evaluations and recommendations for Fort Hood's Cultural Resources Management Program.

Four appendices are included, and three consist of detailed special studies. Soil-stratigraphic descriptions for seven backhoe trenches and one test unit are presented in Appendix A. Dr. Phil Dering (Archeobotanical Laboratory, Texas A&M University) did the macrobotanical analysis presented in Appendix B, and an in depth discussion of the edible plant remains is included. Appendix C discusses the analysis Dr. Mary Malainey and Dr. Kris Malisza (Department of Native Studies, Brandon University, Manitoba, Canada) performed of the lipid residue extracted from burned rocks and one metate. The tables in Appendix D provide detailed provenience data for all artifacts recovered from 41CV595. Finally, Appendix E presents archeological data on all the Paluxy sites on Fort Hood that are considered eligible for listing in the National Register of Historic Places.

ENVIRONMENTAL BACKGROUND

Karl W. Kibler

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Fort Hood is situated in the Lampasas Cut Plain, a subprovince of the Grand Prairie (Hayward et al. 1996) and dissected northeastern edge of the Edwards Plateau (Hill 1901). This 339-mi^2 area represents a transitional zone from the more humid east to the semi-arid west, and the environmental gradient is steep enough that distinct changes in landscape and vegetation are observable moving east to west across Fort Hood. Geologically, Fort Hood lies west of the Balcones Fault Zone on lower Cretaceous carbonate rocks. No clear and distinct escarpment exists along the fault zone in the Fort Hood area, but marked differences do exist between the soils and vegetation developed on the upper Cretaceous (Gulfian Series) rocks east of the fault zone and those developed on the lower Cretaceous (Comanchean Series) rocks to the west (Abbott 1995:5).

CLIMATE

The modern climate of the Fort Hood area is subtropical, characterized by hot, humid summers and relatively short, dry winters (Natural Fibers Information Center 1987:6). The prevailing wind blows from the south, reaching its peak during the spring. Summer temperatures are high, with an overall average of 83°F (28.3°C) and an average daily maximum of 96°F (35.5°C) in Coryell County. The average temperature in winter is 49°F (9.4°C) but tends to vary considerably with the periodic passage of northern cold fronts, resulting in a pattern of alternating cold and mild days (McCaleb 1985:3).

Annual precipitation is approximately 32.5 inches (826 mm) for Coryell County (Natural Fibers Information Center 1987:121). Although rainfall occurs year round, the overall distribution pattern is bimodal, with peak rainfall in the late spring and early fall.

FLORA AND FAUNA

The flora and fauna of Fort Hood are typical of the Balconian and Texan biotic provinces (Blair 1950). The biotic assemblage represents a mix of species from the Blackland Prairie to the east and the Edwards Plateau to the west. Many specific ecological niches also exist across the base, depending on the local topography, slope aspect, soil, and geology. Dense juniper and oak forest and scrub now characterize the eastern side of the facility, but upland areas to the west and south are generally more open. Grasslands are most prevalent on the intermediate upland surfaces. The high upland surface is typically covered by juniper and oak scrub. Riparian zones, exhibiting a variety of hardwood species, are common along drainages.

The Balconian faunal assemblage includes 57 species of mammals, but none of these are solely restricted to the Balconian province (Blair 1950:113). Eight of these species also inhabit the Texan province to the east and the interconnecting riparian zones (Blair 1950:101). Other native fauna include 36 species of snakes, 15 anuran species, and 16 species of lizards. In historic times, several prehistorically significant economic species, such as bison and pronghorn antelope, have been removed from the area.

GEOLOGY, GEOMORPHOLOGY, AND LATE QUATERNARY STRATIGRAPHY

The Fort Hood landscape consists of the dissected northeastern margin of the uplifted

Edwards Plateau and reflects the variable resistances of the various underlying geologic formations to erosion. Structurally, the area is underlain by a deeply buried extension of the Paleozoic Ouachita Mountains, which divide the stable continental interior to the west from the subsiding Gulf basin to the southeast. During the Cretaceous Period, this region consisted of a very broad shelf covered by a shallow sea. Limestones and marls were deposited on the shelf as the shoreline fluctuated for more than 80 million years. Occasionally, relatively thin deposits of sand derived from terrestrial sources also accumulated on the shelf, resulting in interbedded formations like the Paluxy Formation and Trinity Sands. The Gulf Basin subsided during the Miocene, and the Balcones Fault Zone developed along the old Ouachita line and the uplift of the Edwards Plateau (Woodruff and Abbott 1986). West of the Balcones Fault, the Cretaceous limestones and marls remain relatively horizontal and structurally unmodified, but to the east the Cretaceous rocks dip sharply gulfward and are buried deeply by Gulfian and later lithological units.

Because Fort Hood is west of the fault zone, relatively flat-lying lower Cretaceous rocks showing a two-tiered topography (Figure 2.1) locally termed the Lampasas Cut Plain underlie it (Hayward et al. 1990). This landscape developed between the Brazos and Colorado Rivers and consists of large, mesa-like remnants of an early Tertiary planation surface surrounded by a broad, rolling pediplain formed during the late Tertiary and early Quaternary. These two surfaces differ by 25 to 40 m in elevation and form the "high" and "intermediate" uplands of Hayward et al. (1990) and the "Manning" and "Killeen" surfaces of Nordt (1992). Modern stream valleys are incised approximately 40 to 70 m into the pediplain surface.

The oldest rocks exposed at Fort Hood belong to the lower Cretaceous Trinity Group, which includes the Glen Rose Formation. This formation is surficially exposed on the western side of Fort Hood, where relatively deep incision of the landscape by Cowhouse Creek and its tributaries has removed the overlying rocks (Proctor et al. 1970; Sellards et al. 1932).

Resting on the Trinity Group are rocks of the lower Cretaceous Fredericksburg Group. The lowest unit is the Paluxy Formation, a terrigenous siliclastic unit of strandplain, fluvial, and deltaic deposits. The Walnut Clay, which is widely exposed at Fort Hood and forms the principle substrate of the Killeen surface, overlies the Paluxy Formation. Above the Walnut Clay lies the Comanche Peak Limestone, which forms the intermediate slopes of the higher Manning surface. The highest extensive lithological unit is the Edwards Limestone, which forms the resistant cap of the high upland mesas or Manning surface. The Edwards Limestone also is a very important source of high-quality chert (see Frederick and Ringstaff 1994; Frederick et al. 1994).

Nordt (1992, 1993, 1995), who identifies six principal alluvial units in the study area, has examined the stratigraphy and soil geomorphology of a number of larger Fort Hood streams in detail. From oldest to youngest, these units are termed the Reserve alluvium, Jackson alluvium, Georgetown alluvium, Fort Hood alluvium, West Range alluvium, and Ford alluvium (Nordt 1992).

ENVIRONMENTAL SETTING FOR PALUXY SITES

Paluxy sites rest on the sandy deposits of the Paluxy Formation or are encapsulated in late Quaternary colluvial and sheetwash sediments derived from the Paluxy and overlying Walnut formations. These deposits and sediments occur along the upper margins of Pleistocene valleys across the west-central portion of Fort Hood, where the Paluxy Formation crops out below the Killeen surface. These sandy deposits are pedogenically altered and form soil catenas across the sites that vary according to differences in ages and local topography. These soils are typically classified as Cisco and Wise series soils (McCaleb 1985). Cisco soils are Alfisols with well-developed argillic horizons, and Wise soils are weakly developed sandy Inceptisols.

Climax plant communities on the sandy Paluxy sediments vary from true prairies consisting mainly of tall grasses to post oak-blackjack oak savannah of tall and mid grasses (McCaleb 1985). The tall grass prairies primarily consist of little bluestem (*Schizachyrium scoparium*), switchgrass (*Panicum virgatum*), big bluestem (*Andropogon gerardii*), and Indiangrass (*Sorghastrum nutans*), which heavy grazing easily disturbs. Forbs and trees are minor components (< 30 percent) of this

Errata Page (corrected figure) for *Shifting Sands and Geophytes*, by Mehalchick, Boyd, Kibler, and Ringstaff, 2004.

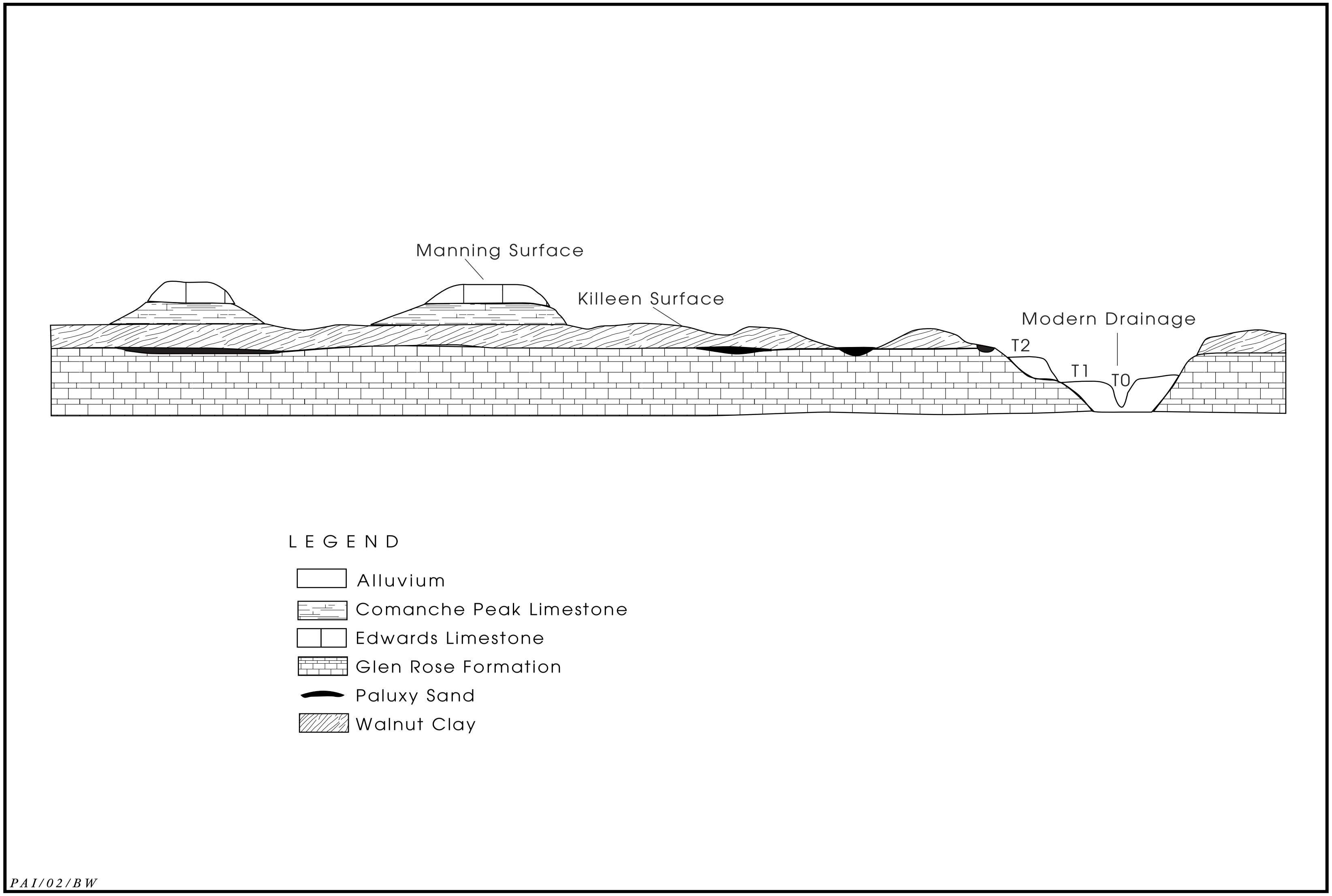


Figure 2.1. Generalized geologic cross section of the Lampasas Cut Plain, central Texas (adapted from Nordt 1992:Figure 3).

community but include Gayfeather (*Liatris elegans*), Engelmann's daisy (*Engelmannia pinnatifida*), Maximilian sunflower (*Helianthus maximiliani*), American elm (*Ulmus americana*), common hackberry (*Celtis occidentalis*), and live oak (*Quercus virginiana*) (McCaleb 1985:38). Arboreal species of the post oak-blackjack oak savannah include post oak (*Q. stellata*), blackjack oak (*Q. marilandica*), American elm, Mexican plum (*Prunus mexicana*), American beautyberry (*Callicarpa americana*), and hawthorn (*Crataegus* sp.). The oak canopy shades approximately 20 percent of the ground. Grasses such as little bluestem, big bluestem, Indiangrass, switchgrass, beaked panicum (*Panicum anceps*), purpletop tridens (*Tridens flavus*), sand lovegrass (*Eragrostis trichodes*), Virginia wildrye (*Elymus virginicus*), and Canada wildrye (*Elymus canadensis*) make up 80 percent of the vegetative community and are sensitive to overgrazing (McCaleb 1985:40). Kleinbach et al. (1999:Table 86) present a detailed listing of vascular plants observed at Paluxy sites on Fort Hood during the spring of 1997.

Abbott and Trierweiler (1995a) and Kibler's (1999) studies of Paluxy sites show that colluvial and sheetwash or rillwash deposition was and continues to be important in forming these sites and a significant means of site burial. Throughout the late Quaternary, the sandy deposits were subject to cycles of gully formation and erosion, deposition, and soil formation.

Abbott and Trierweiler's (1995a:475) interpretation of the chronostratigraphy and pedology of Paluxy sites based on their observations at 41CV595 identified three cycles or units of erosion, deposition, and pedogenesis. The most recent cycle, Unit 3, dates to the late Holocene and characteristically consists of a thin mantle, generally <20 cm thick (although deposits up to 180 cm thick may fill gullies cut into the underlying unit) of very dark grayish brown loamy sand to sandy loam sediments. This sandy mantle typically displays an A horizon or, in thicker deposits, an A-E soil profile. Weak Bk horizons also may form in thicker deposits. Unit 2 is late Pleistocene to early Holocene and is imprinted with a well-developed, yellowish red sandy clay Bt horizon, which grades to a reddish yellow to yellow sand to loamy sand BC horizon. This soil is almost always truncated, but intact profiles including the A horizon have been observed buried on lower sections of the slope (Abbott 1994:329). Unit 2 may rest on Unit 1 or unweathered Paluxy Formation sediments. Unit 1 is Pleistocene sediment imprinted with a reddish yellow to yellowish red loamy sand and sand Bk-BC soil profile. Abbott and Trierweiler (1995) noted that further investigations directed at dating the units were needed, as well as more data on the natural processes (e.g., mode of deposition, bioturbation) involved in site formation.

In 1996, Kibler (1999) conducted a detailed geomorphic study of selected locations to define the chronostratigraphy of Paluxy sites and to identify the depositional processes responsible for their formation. Two stratigraphic units were discerned at the observed Paluxy sites, Strata I and II. Stratum I is late Holocene and contains all cultural features and artifacts found at Paluxy sites. Based on radiocarbon assays, primarily of wood charcoal from buried cultural features, Stratum I accumulated between ca. 3500 and 500 B.P. at most Paluxy sites. Stratum I is typically less than 50 cm thick, pinching out downslope, although Stratum I sediments more than 100 cm thick filling erosional gullies are not uncommon. The sediments are typically dark loamy sands to sandy loams imprinted with A, A-E, or A-Bw soil profiles. The contact between Strata I and II is abrupt to very abrupt and wavy.

The age of the lower Stratum II is not known, although it is fairly clear that it was truncated by ca. 5000–4000 B.P. Because no in situ cultural materials or features have ever been observed in any preserved portions of Stratum II, it is believed that it started to accumulate during the late Pleistocene. The top of Stratum II is marked by a well-developed truncated Bt horizon. The Bt horizon is typically a sandy clay loam and grades in color upslope from more red hues to more brown hues. Soil structure also grades upslope from strong, medium to coarse, blocky peds to moderate blocky peds or weak, coarse, prismatic peds breaking to moderate blocky peds. The Bt horizon overlies a BC horizon, which is typically a sandy loam to sandy clay loam. As with the Bt horizon, color and soil structure vary topographically. Stratum II typically rests directly on the Glen Rose limestone, although at a few sites a late Pleistocene caliche was observed underlying Stratum II.

Deposition of these sediments appears to be dominated by surface flow in the form of sheetwash or rillwash and raindrop impact. Mass wasting was also probably an important depositional process in the early formation of many Paluxy sites. Ultimately, however, two factors allowed a Paluxy site environment to form: the thickness of the Paluxy Formation outcrop, which when undercut promotes retreat of the Paluxy and Walnut Formations and formation of colluvial deposits, and a low gradient of the more-resistant Glen Rose limestone downslope, which promotes accumulation of the colluvial sediments. These factors coexist throughout the west-central portion of Fort Hood, primarily north of House Creek, south of Shell and Manning Mountains, and west of West Range Road to the western boundary of Fort Hood (see Figure 1.2).

Paluxy sites on Fort Hood formed in areas where Paluxy Formation outcrops were relatively thick, usually greater than 3 m, and occurred above low-gradient Glen Rose limestone slopes. Kibler (1999) noted that many of the examined Paluxy sites appear to be nothing more than an accumulation of redeposited Paluxy sands and Walnut Formation sediments, though at some sites—particularly on the upper slopes—it is conceivable that the sandy deposits are in fact a highly weathered but intact Paluxy Formation sand. Regardless of how Paluxy sites formed, prehistoric peoples used large pockets of well-drained sandy soils within vast areas dominated by limestone bedrock because they provided an excellent setting for camping and other activities. The real attraction, it will be argued later, is that sandy Paluxy localities were specialized niches and conveniently situated close to prolific patches of specific plants that prehistoric hunter-gatherers targeted for bulk resource acquisition and processing.

ARCHEOLOGICAL BACKGROUND AND RESEARCH CONTEXTS

Douglas K. Boyd, Karl W. Kibler, and Gemma Mehalchick

3

REGIONAL CULTURAL CHRONOLOGY

The prehistoric cultural-historical framework incorporating discrete temporal and technological units that Prewitt (1981, 1985) delineated and defined and Johnson and Goode (1994) and Collins (1995) refined has been discussed in detail in several Fort Hood reports (Kleinbach et al. 1999; Mehalchick, Killian et al. 2000; Mehalchick, Kleinbach et al. 1999, 2000). Although the three chronologies have value, Collins (1995) is used because it represents high-integrity sites with stratigraphically discrete components (Figure 3.1). The chronology is summarized below.

The Paleoindian period (11,500–8800 B.P.) represents the earliest known cultural manifestation in North America. Sites and isolated artifacts from this period are fairly common across central Texas. Highly mobile bands who were specialized hunters of Pleistocene megafauna often characterized the period. But a more accurate view of Paleoindian life includes exploitation of diverse subsistence resources. Recent investigations at the Wilson-Leonard site (41WM235) support this view and challenge the fundamental defining criteria of the Paleoindian period, that of artifacts in association with late Pleistocene megafauna (Collins 1998:159).

The Archaic period (8800 to 1300–1200 B.P.) is generally believed to represent a shift toward hunting and gathering of a wider array of animal and plant resources and a decrease in group mobility (Willey and Phillips 1958:107–108), although such changes may have been well under way by the beginning of the period. Both Collins (1995) and Johnson and Goode (1994) recognize a period of extreme aridity in central Texas during the Archaic period; construction and use of burned rock middens were probable responses to these xeric conditions. As do Nordt et al. (1994) and Toomey et al. (1993)—Collins (1995) views these xeric conditions as the culmination of a continual decrease in effective moisture since the end of the Pleistocene, but Johnson and Goode (1994) do not. The Archaic is generally subdivided into Early, Middle, and Late subperiods (Black 1989; Collins 1995; Story 1985:28–29).

Early Archaic (8800–6000 B.P.) sites are small with very diverse tool assemblages (Weir 1976:115–122), which suggests that groups were highly mobile and population densities were low (Prewitt 1985:217). It has been noted that Early Archaic sites are concentrated along the eastern and southern margins of the Edwards Plateau (Johnson and Goode 1994; McKinney 1981). Not coincidentally, this is the area where many large fresh water springs emerge from the Edwards Aquifer along the Balcones Escarpment (Mehalchick and Boyd 1999:Figure 64 and Table 27). The fact that Early Archaic sites are most concentrated in an area with a diverse subsistence base and reliable water sources may reflect the generally harsh environmental conditions associated with a long period of extreme aridity. Construction and use of rock hearths and ovens reflect a specialized subsistence strategy (possible exploitation of roots and tubers) during the Early Archaic. These burned rock features most likely represent the technological predecessors of the larger burned rock middens used extensively later in the Archaic period (Collins 1995:383).

During the Middle Archaic period (6000–4000 B.P.), archeologists see an increase in the number and distribution of sites, as well as in

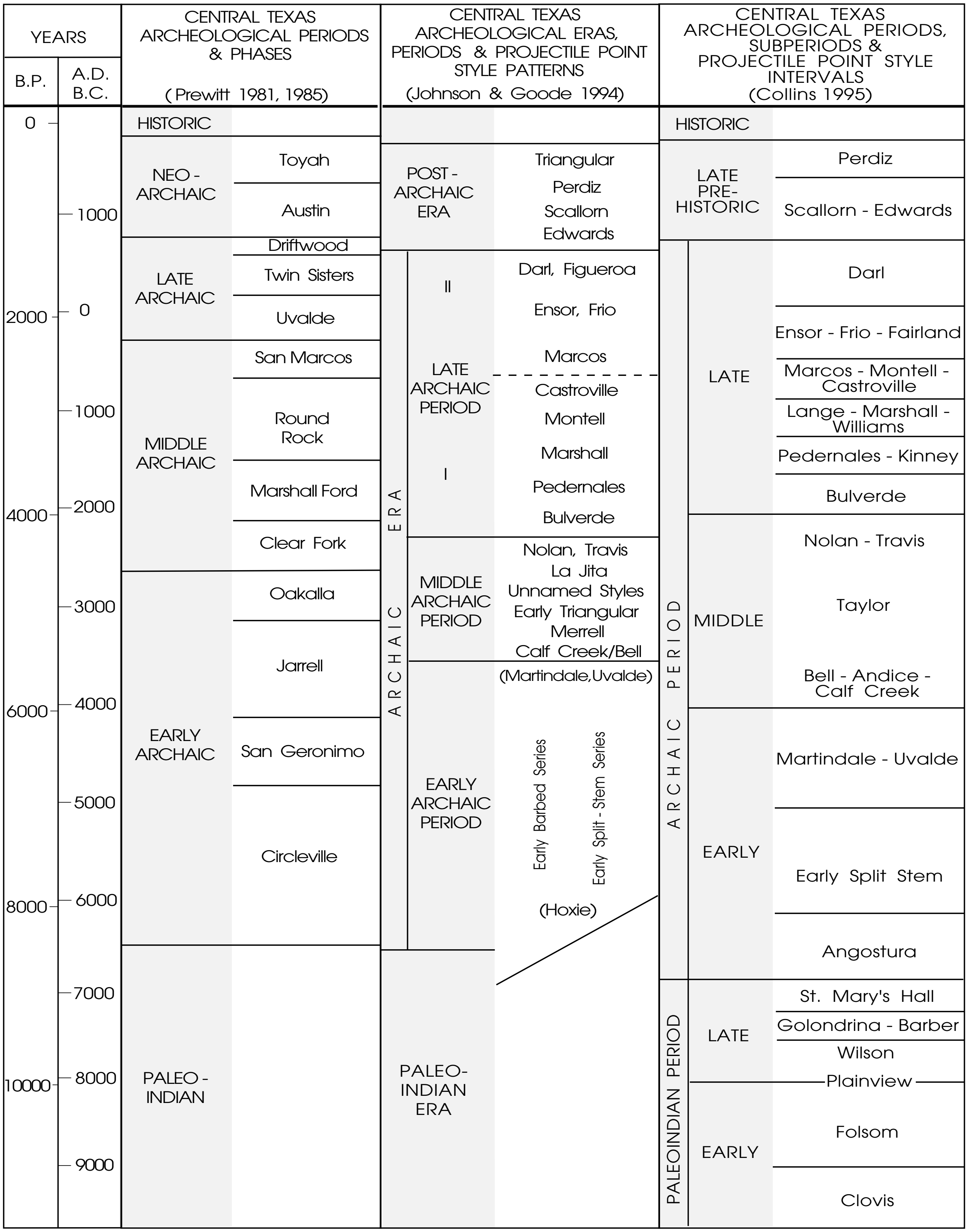


Figure 3.1. Prehistoric cultural sequences of Prewitt (1981, 1985:Figure 5), Johnson and Goode (1994:Figure 2), and Collins (1995:Table 2).

the size of individual sites. This increase may reflect increasing population densities beginning about 5000–4500 years B.P. (Prewitt 1981:73; Weir 1976:124,135). Macrobands may have formed at least seasonally, or several small groups may have used the same sites for longer periods (Weir 1976:130–131). The presence of burned rock middens suggests a shift in the technology of processing plant foods toward the end of the Middle Archaic, although tool kits still imply a strong reliance on hunting (Prewitt 1985:222–226).

Johnson and Goode (1994:26) speculate that dry conditions may have promoted the spread of xerophytic plants such as yucca and sotol and that late Middle Archaic peoples collected and cooked these plants in large rock ovens. Other researchers suggest that climate change does not necessarily explain cultural change (Ellis et al. 1995:411–414).

During the succeeding Late Archaic period (4000 to 1300–1200 B.P.), populations continued to increase (Prewitt 1985:217). Establishment of large cemeteries along drainages suggests certain groups had strong territorial ties (Story 1985:40). Xeric conditions continued but gradually became more mesic around 3500–2500 B.P. According to Collins (1995:384), construction and use of burned rock middens reached a zenith near the middle of the Late Archaic and declined during the latter half of the period, but mounting chronological data suggest that midden formation and use culminated much later near the end of the Late Archaic period and that this high level of use continued into the early Late Prehistoric period (Black et al. 1997; Kleinbach et al. 1995:795).

Nevertheless, it is clear that burned rock midden use in the eastern part of central Texas was still prevalent after 2000 B.P. (Black et al. 1997:Figure 133). This scenario parallels the widely recognized occurrence of post-2000 B.P. middens in the western reaches of the Edwards Plateau (see Goode 1991). The use of burned rock middens appears to have been a major part of the subsistence strategies as a decrease in the importance of hunting, implied by the low ratios of projectile points to other tools in site assemblages, may have occurred (Prewitt 1981:74).

The Late Prehistoric period (ca. 1300–1200 to 300 B.P.) is marked first by introduction of the bow and arrow into the region and later by the appearance of ceramics. These innovations may have come from the north, but the mode of transfer and peoples involved are unknown (Prewitt 1985:228). Population densities dropped considerably from their Late Archaic peak (Prewitt 1985:217). Subsistence strategies did not differ greatly from the preceding period, although bison became an important economic resource during the later part of the Late Prehistoric period (Prewitt 1981:74). The use of burned rock middens for plant food processing continued throughout the Late Prehistoric period (Black et al. 1997; Goode 1991; Kleinbach et al. 1995:795). Recent research has shown a possible connection between specific plant foods—particularly geophytes—and earth oven cooking resulting in burned rock middens (see Chapters 8 and 9). Horticulture came into play very late in central Texas and was of minor importance to the overall subsistence strategy (Collins 1995:385).

Bolton (1915), Campbell (1988), Campbell and Campbell (1981), Hester (1989), and Newcomb (1961) provide historical accounts of Native Americans and their interactions with the Spanish, the Republic of Mexico, the Texas Republic, and the United States throughout the region. Collins (1995:386) divides this period into three subperiods. Although Europeans first made contact with Native Americans in Texas in the sixteenth century, the late seventeenth and early eighteenth centuries mark an era of more-permanent contact between the two groups as the Spanish moved northward out of Mexico to establish settlements and missions on their northern frontier.

There is little available information on aboriginal groups and their ways of life except for fragmentary data Spanish missionaries gathered. In the San Antonio and south Texas areas, these groups have been collectively referred to as Coahuiltecans because of an assumed similar lifestyle. But many individual groups undoubtedly existed (Campbell 1988). The inevitable and disastrous effects on native social structures and economic systems from disease and hostile encounters with Europeans and intruding groups like the Apache were already under way at this time.

The second subperiod spans from establishment of the mission system in the 1720s to its ultimate demise around 1800. Some indigenous groups moved peacefully into mission life, giving up their nomadic hunting and gathering ways. Others were forced in or moved in to escape the increasingly hostile actions of southward-advancing Apaches and Comanches. By the end of this time, European expansion and disease had decimated many Native American groups. Intrusive groups like the Tonkawa, Apache, and Comanche moved into the region to fill the void. Few sites attributable to these groups, outside of mission sites, have been recognized and investigated.

To complicate matters, some aspects of aboriginal lifestyles continued after Spanish contact. For example, many groups continued to manufacture stone tools after settling in the missions (Fox 1979). The third subperiod, from 1800 to the last half of the nineteenth century, witnessed the final decimation of indigenous groups and U.S. defeat and removal of the Apaches and Comanches to reservations. According to various Native American groups, Fort Hood falls within the territorial ranges of the Comanche, Kiowa, Tonkawa, and Wichita (Patterson 2001).

HUNTER-GATHERER THEORY AND MIDDLE-RANGE RESEARCH

Foraging or hunter-gatherer theories are an appropriate research strategy for central Texas because archeological research to date suggests that all prehistoric peoples in the region were hunter-gatherers throughout all cultural periods (Collins 1995). Foraging theories and hunter-gatherer models come in many different flavors (e.g., optimal foraging strategy, prey and patch, structural Marxism, NeoDarwinism), but all employ an ecological approach (whether biological or cultural) and have the common goal of understanding human behavior by documenting the geographic distribution of resources and how humans organized their lifestyles to exploit those resources over time. The best way to bridge the gap between archeological remains and interpretation of human behavior is to develop archeological research designs that use middle-range research along with some variation of hunter-gatherer or foraging theory.

Although Bettinger (1991:64) argues that there is no agreement on a precise definition of middle-range research, two commonly accepted general definitions are "an enterprise devoted to the assigning of meaning to empirical observations about the archeological record" (Bettinger 1991:62), or "the analysis of linkages between static archeological data and the dynamics of past human behavior" (Binford [1981] as interpreted by Ellis et al. [1994:78]). One of the most widely used middle-range theories for interpreting hunter-gatherer archeology in North America is Binford's (1980) forager-collector model of resource acquisition.

Behavioral Ecology Theory and Optimal Foraging Strategy

Kelly (1995:39–64) summarizes the development of hunter-gatherer anthropological theory and notes that all of the recent and most widely accepted foraging theories and models have an ecological basis. Such ideas are intimately tied to the concept of human adaptation to the environment, and all ecologically based theories acknowledge that human life is an interaction between physical and social environments (Kelly 1995:62).

As an outgrowth of the popular culture-area concept, Julian Steward (1955) coined the term cultural ecology in 1955 to explain the relationships between human society, technology, and environment. This approach became a guiding paradigm for many years, and several cultural ecology models were proposed and employed in anthropology and archeology. In the 1960s and 1970s, some researchers found cultural ecology inadequate for explaining the complexities of human behavior, primarily because it deals with a group (i.e., the culture) and does not recognize decision making, interactions, and conflicts between members of the group.

The paradigm began to shift toward evolutionary ecology (Bamforth 1988:17, 2002:436–437; Winterhalder 1981:14–15). Evolutionary ecology, or behavioral ecology as Kelly (1995:50–51) defined it, focuses on natural selection as it relates to human behavior to understand "both variation *within* and *between* populations." He suggests that, "Behavioral ecology does not replace cultural ecology. Instead, it makes it more complete by adding the concept of natural selection." Within behavioral ecology is the assumption of optimization (Smith 1979; Winterhalder 1981), from which more theoretical advancements have sprung.

The idea of optimal foraging was first applied to explain nonhuman foraging behavior, and its simple meaning is that "the goal of a forager should be to forage optimally, that is, to maximize the net rate of food intake" (Kelly 1995:55). All foraging creatures, and this applies to humans as well, will "tend toward…a maximization of foraging efficiency." Although they seldom achieve this level of efficiency, the goal is to maximize the amount of food gathered in relation to the amount of effort expended, and both may be measured in terms of energy (food nutritional value vs. caloric expenditure).

Behavioral ecology has many proponents in anthropology, and optimal foraging theories have become very popular in ethnographic and archeological studies (Smith 1979; Smith and Winterhalder 1992; Winterhalder 1983, 1987; Winterhalder and Smith 1981; Yesner 1987). Binford's (1980) forager-collector model, discussed below, represents but one of many different foraging models that stem from behavioral ecology theory. This model is derived from optimal foraging theory as defined by Winterhalder (1981, 1983), but it has some major advantages over many other similar models. Most anthropological optimal foraging models were developed using ethnographic data on subsistence resources and optimal strategies for procurement. Such models are especially effective when a great deal of knowledge is available about a particular environment and the distribution of subsistence resources within it.

When some optimal foraging models are applied to the archeological record, however, their usefulness may be limited because of gaps in environmental knowledge. This is particularly true for prehistory, and the task becomes more difficult as one moves further back in time. In central Texas, for example, it is difficult to talk about optimal foraging strategies for most prehistoric periods because we know very little about the distribution and abundance of most of the resources that were exploited. The critical advantage of Binford's (1980) forager-collector model is that the archeological remains (i.e., sites) should reflect the type of subsistence strategy that people employed (i.e., their behavior) to exploit a particular resource or set of resources even if those resources cannot be positively identified. Consequently, the forager-collector model is an especially appropriate level of optimal foraging model for investigating prehistoric hunter-gatherer behavior in central Texas.

Foragers and Collectors

Binford's (1980) analytical classification of hunter-gatherer adaptive systems is "an elegantly constructed model in which availability of natural resources is seen to dictate differing combinations of social, economic, and settlement systems" (Bettinger 1991:64). The model proposes a continuum of subsistence-settlement combinations ranging from highly mobile foragers to sedentary collectors. The geographic and seasonal distribution of resources, both in terms of quantity and quality, determine human adaptive strategies. Table 3.1 summarizes the differences between the two extremes in adaptive strategy—foraging vs. collecting.

From an archeological perspective, Binford's (1980) Forager-Collector model predicts that environmental productivity (i.e., the biomass of edible plants and animals) of the land will dictate how people will organize their subsistence activities to exploit different resources. This, in turn, determines the kinds of physical remains they leave behind and the kinds of sites found in the archeological record. In this model, Binford uses Effective Temperature (ET) in degrees Celsius as the yardstick to measure the productivity of the environment when comparing different areas (see Bettinger [1991:65] for a good discussion of ET and the formula for figuring the ET of an area). This model then predicts that Fort Hood, with an ET of 15.3º (for

Table 3.1. Ideal characteristics of foragers and collectors

Category	Forager	Collector
Environment	Aseasonal Even	Seasonal Patchy
Settlements	Residential base Location	Residential base Location Field camp Station Caches
Mobility	Residential	Logistical
Technology	Generalized	Specialized Curated
Pattern of exploitation	Low intake	Bulk intake
Hunting	Encounter	Intercept

Note: From Bettinger 1991:Table 3.1.

Coryell County), is roughly in the middle of the expected forager-collector continuum (Figure 3.2).

Abundant and similar resources distributed evenly throughout the year characterize a high ET, such as is found in many tropical and desert environments. Given these characteristics, the model predicts that hunter-gatherer peoples will employ a forager subsistence strategy and have high residential mobility, moving their base camps to be close to the resources they are seeking. In contrast, the model predicts that in areas with low ET, essentially cold climates with pronounced seasonal variations, people will employ a collector subsistence strategy to exploit resources that are unevenly distributed across space (i.e., patchy distribution) and very seasonal in nature.

A collector strategy involves logistical mobility, moving residential bases to general areas where resources are available, but then procuring resources using specialized task groups. Collectors also process and store foods in bulk to build up a supply of resources that are relatively abundant during specific seasons so that they can be used during the winter when few resources are available.

A major drawback in Binford's (1980) ET model is that the concept is overly simple and ignores an important variable—precipitation. According to the model, the overall biomass productivity of two places with similar ETs should be roughly similar. Thus, one would expect El Paso County, with an ET of 14.9°, to be similar in overall biomass productivity to Fort Hood, with its ET of 15.3°. Although this may be generally true, it is obvious that the difference in mean annual precipitation between the two places (i.e., El Paso County receives 7.8 inches per year, but Coryell County gets 32.5 inches) is significant. The amount of precipitation affects the quality and quantity of potential food resources tremendously in these areas, and that in turn dictates the forms that human adaptation may take. Despite this shortcoming, the forager-collector model of hunter-gatherer subsistence is a useful tool because it forces us to acknowledge and study the variability in human adaptation to various environments. The model predicts that prehistoric hunter-gatherers who lived in the Fort Hood area could have employed a variable mix of strategies to exploit a highly variable resource base.

The utility of the forager-collector model for central Texas archeology, then, is that a wide range of testable hypotheses can be formulated for any particular period, culture, and exploited food resource. Because it is a cultural ecology model—one that stresses the relationships between people and resources across vast areas—it is particularly well suited to archeological research at Fort Hood. Ingrained within the forager-collector model is the concept of how differential resource distribution relates to

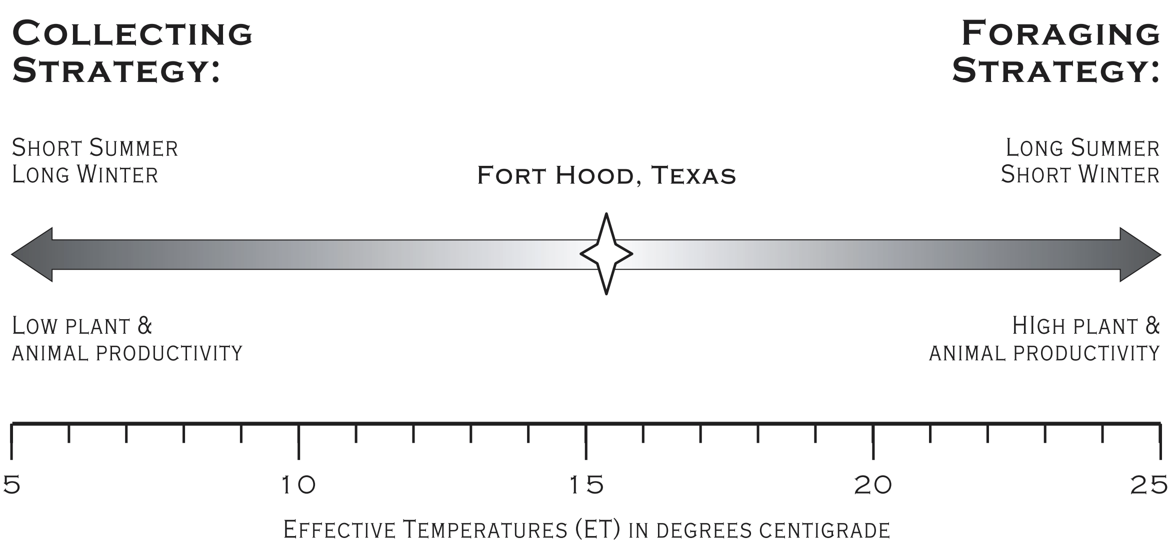


Figure 3.2. Schematic diagram of Binford's (1980) forager-collector model of adaptive strategies employed by hunter-gatherer peoples.

hunter-gatherer mobility and land use. This relationship may be addressed using site-specific archeological data by asking research questions, in the form of testable hypotheses, to analyze site function (what activities took place at any given location) and site catchment (i.e., the area from which the inhabitants of a site exploited various resources). The model also is useful for long-term regional research using Fort Hood archeological data for spatial analyses in conjunction with geographic information system (GIS) data sets (e.g., geological, sedimentological, environmental, topographical).

PREHISTORIC RESEARCH CONTEXT

Formal testing data from Paluxy sites at Fort Hood demonstrates multiple cultural components are buried in late Holocene colluvial sediments that accumulated between ca. 3500 and 500 B.P. (Kleinbach et al. 1999:381–392). Radiocarbon assays provide an age estimate for 21 cultural features or occupations (Kleinbach et al. 1999:Figure 151) and indicate primary use of the Paluxy environment during the Late Archaic and Late Prehistoric periods. The entire regional cultural sequence is discussed above because the types of resources and activities represented at Paluxy sites are similar to those at many other non-Paluxy sites in central Texas during much of the past 12,000 years of human prehistory.

Broad research questions center on why prehistoric sites occur near the Paluxy sands and why people transported large quantities of limestone rock into these areas and then heated them. Abbott (1994, 1995c) proposes three hypotheses explaining why prehistoric people purposefully chose the Paluxy setting. The first hypothesis states that there is a unique or concentrated plant food or fuel resource in the Paluxy environment. The second and third hypotheses focus on the substrate, suggesting the sandy soil provided rapid drainage of runoff, and the sediments and naturally occurring gullies allowed for easier preparation of cooking pits.

Although these hypotheses are not mutually exclusive, later investigations support the first (Kleinbach et al. 1999:387–392; Mehalchick et al. 2000:335–338). In a research design for Paluxy sites, Boyd et al. (2000:34–37) state that the first hypothesis is preferred because it may be archeologically testable, and current evidence indicates plant resources are the primary focus of subsistence activities at these localities.

Abbott (1994, 1995c) and Boyd et al. (2000) also suggest unique plant resources may cluster in and around Paluxy sites but be absent or in diminished quantities in other locations (e.g., riparian settings), making these locales attractive to foragers. Fragments of bulbs and corms (underground stem used for food storage) recovered from Paluxy sites lend more credence to this theory. If the theory proves true, exploitation of such resources, and hence occupations of these sites, were probably periodic and highly seasonal. If the activities at Paluxy localities centered on plant gathering and processing, then the stone tools and cooking apparatus (i.e., features) should reflect this behavior and may be significantly different from campsites in other parts of the landscapes. Therefore, interpretations of prehistoric activities will be most productive if significant excavation samples from multiple Paluxy sites can be compared, and the "Paluxy site data will be most meaningful when compared to data from other residential sites" (Boyd et al. 2000:36).

Based on a comparison of artifact assemblages recovered from testing 23 Paluxy sites on Fort Hood, Abbott (1995c:821) concluded that "it can no longer be argued that Paluxy sites are artifactually distinct from other sites on the base." This statement refers primarily to the density of lithic artifacts (expressed as number of lithic artifacts per 10 cm level or cubic meter) on Paluxy sites as compared to other types of sites.

Although this suggestion may be valid, Boyd et al. (2000:34–36, Table 15) demonstrate that Paluxy cultural assemblages can be separated into those with high or low artifact density. These distinctions may reflect differences in overall occupation intensity or indicate differential site function. They proposed that high-density assemblages may correspond to multifunctional campsites and should exhibit a high degree of diversity. In contrast, low-density assemblages would be less variable, thus representing a smaller suite of activities, and perhaps indicate specialization in site function.

None of the previous researchers (Abbott 1995c; Boyd et al. 2000; Kleinbach et al. 1999) have proposed any interpretations of Paluxy site function based on comprehensive analyses of artifact assemblages. Such interpretations have not been possible because samples of lithic artifacts, particularly stone tools, derived from limited testing have been too small to support functional interpretations or comparative analyses. Chapter 9 discusses this situation.

PALUXY SITE RESEARCH QUESTIONS

Of Abbott's (1994, 1995c) three hypotheses, the preferred hypothesis for organizing Paluxy site research may be restated as follows:

> Prehistoric peoples used Paluxy localities selectively because there was a unique or concentrated plant food and wood fuel resource on or near the Paluxy environment.

In addition to this general hypothesis, a series of research questions were proposed before the Paluxy project fieldwork began and were modified slightly during the course of the investigations. These questions are organized within six categories and further grouped into site-specific questions (that pertain to a single site) and general questions (that pertain to intersite variability and regional studies).

The site specific questions presented below guided the data recovery at the Firebreak site, and the general questions provide an outline for archeological research at all Paluxy sites. The site specific questions listed below are addressed for the Firebreak site in Chapter 8.

Chronology

Site-specific Questions

When did site occupation begin and end?

How many components (i.e., discrete periods of occupation) can be defined?

Are the radiocarbon dates, temporally diagnostic artifacts, and stratigraphic integrity sufficient to help reconstruct a relative chronology for the site?

Are there enough contextual links between absolute dates and temporally diagnostic artifacts to contribute to the regional chronology reconstructions?

General Questions

What is the total span of human occupations of the Paluxy environment on Fort Hood?

Does the intensity of Paluxy occupations change over time or remain consistent?

What analytical techniques will provide data useful for constructing an absolute chronology for the site (e.g., radiocarbon dating of various organic materials, snail A/I ratio analysis, archeomagnetic dating)?

Site Formation

Site-specific Questions

To what extent does the spatial patterning (both vertical and horizontal) of artifacts reflect cultural or natural processes (e.g., colluvial slopewash)?

What does the geomorphic, chronological, and archeological evidence reveal about site formation and the number and intensity of occupations?

How do the site formation processes represented at one site fit with what is known about such processes at other Paluxy sites?

General Questions

Can sediment textural analyses contribute to an understanding of environments and rates of deposition or site formation?

What other analytical techniques, such as amino acid racemization analysis of land snail shells, might contribute to an understanding of rates of deposition or site formation at Paluxy sites?

Taking all of the Fort Hood Paluxy site data into account, how do the natural and cultural processes interact in this setting?

To what extent do the natural processes (such as slopewash and bioturbation) that affect Paluxy sediments tend to obscure or obliterate evidence of past cultural activities?

Do the interpretations of site formation processes suggest there are inherent limitations to archeological research at Paluxy sites?

Lithic Procurement and Reduction Strategies

Site-specific Questions

What types and sources of stone were used to make chipped stone tools?

What types and sources of stone were used to make ground stone tools?

What do the finished tools and debitage reveal about manufacturing techniques for stone tools?

What do the broken or reused tools reveal about artifact use-life?

General Questions

Are there consistent and predictable patterns of lithic material procurement for all Paluxy sites on Fort Hood?

Are there consistent and predictable stone tool technologies represented in all of the Paluxy sites on Fort Hood?

How do Paluxy site lithic procurement patterns fit into broader subsistence acquisition and land use patterns?

Subsistence Technologies and Resources

Site-specific Questions

What tools and techniques were used to exploit different plant and animal resources?

What is the direct (such as faunal and botanical remains and organic residues) and indirect evidence (such as functional inferences for stone tools) for exploitation of specific animal and plant resources?

What features were used (or probably used) in cooking and producing food?

How were heating and cooking features constructed?

What was the source of stone for use in heating and cooking features?

What fuel sources were used in heating and cooking features?

General Questions

What are the most common types of subsistence technologies represented in Paluxy sites, and what resource procurement strategies are represented?

How do the subsistence technologies represented in Paluxy sites resemble or differ from those represented in other types of sites (e.g., rockshelters and open campsites)?

What faunal and botanical (i.e., macrobotanical, pollen, and phytoliths) remains constitute evidence of animals and plants exploited by prehistoric peoples in the Paluxy environment?

What is the indirect evidence for exploitation of specific foods (e.g., points and scrapers for animal hunting and processing and ground stones for plant processing)?

Is there much consistency in the archeological subsistence evidence (i.e., faunal and botanical remains) between various Paluxy sites and components?

Do the subsistence technologies or the resources exploited at Paluxy sites remain consistent or change through time?

How does the subsistence resource evidence for Paluxy sites compare with similar evidence for other sites on Fort Hood (e.g., rockshelters and open campsites)?

Site Function and Seasonal Occupation

Site-specific Questions

Do the features, artifacts, and other evidence indicate why the site was occupied and what various types of activities may have taken place there?

What was the use intensity of the site over time?

If use intensity fluctuated through time, what factors may account for this?

What is the evidence for seasonal occupations?

What do the artifacts and features reveal about overall resource procurement strategies?

Do occupations at the site reflect forager or collector subsistence strategies?

General Questions

For any given period when Paluxy sites were occupied, what other types of sites were also occupied and how might Paluxy localities have fit into the overall subsistence patterns and annual movements of hunter-gatherer peoples?

Do Paluxy sites reflect only forager or only collector resource acquisition behaviors, or do Paluxy occupations fit both patterns at different times?

Is there one reason or are there rather many reasons why Paluxy sites were chosen as favorite camping locations at any given time?

What is the likelihood that some types of subtle features (e.g., ephemeral houses or storage pits) once existed on Paluxy sites but are no longer archeologically evident or have yet to be found?

And to what extent might our perception of Paluxy site function be misinterpreted because such archeological evidence is missing?

Paleoenvironmental Research

Site-specific Questions

Can the geomorphic evidence or faunal and botanical assemblages from the site be used to indicate climatic conditions at a particular time?

What do other types of evidence (e.g., carbon and other elemental isotope data) from the site indicate about past climates?

General Questions

Does the paleoenvironmental evidence from all Paluxy sites correspond with or contradict the existing regional climatic reconstructions?

Do patterns of occupation use and intensity at Paluxy sites correspond in any way to long-term environmental or climatic trends evident for central Texas?

Are there any major shifts in tool or subsistence technologies represented at Paluxy sites that may be linked to climatic changes and subsequent changes in resource availability?

WORK ACCOMPLISHED AND METHODS OF INVESTIGATION

Gemma Mehalchick

4

This chapter provides an overview of the field, laboratory, and analysis methods Prewitt and Associates, Inc. (PAI), used during investigations at 41CV595, 41CV988, and 41CV1141 in the summer of 2000. This research is consistent with the *United States Army Cultural Resources Management Plan* (Jackson 1994) and *Significance Standards for Prehistoric Cultural Resources: A Case Study from Fort Hood, Texas* (Ellis et al. 1994). Most of the archeological field methods and analytical techniques employed during these investigations are generally the same as those PAI used in previous seasons from 1995 to 2000 (Mehalchick et al. 1999; Kleinbach et al. 1999; Mehalchick et al. 2000).

PAI or Mariah Associates, Inc. (MAI), did the original testing of these sites between 1992 and 1996: 41CV595 was tested by MAI in 1993, 41CV988 was tested by PAI in 1996, and 41CV1141 was tested by MAI in 1992. Each site was later damaged and was assessed by archeologists from the Fort Hood Cultural Resources Management Program (see Chapters 5, 6, and 7 for detailed discussions of previous work at each site). The archeological investigations described in this report were done in response to the recommendations made during the damage assessment for each site. As described below, this work was accomplished in two phases—additional testing and data recovery.

ADDITIONAL TESTING

The second phase of testing at 41CV595, 41CV988, and 41CV1141 was conducted between 19 July and 15 August 2000. Initially, each site was inspected to identify features, concentrations of cultural materials, and locations of prior excavations and to reevaluate the extent of the recent damage. Previously recorded features and old test units were re-located at each site, and one unrecorded feature was discovered at 41CV595. Denser amounts of stone artifacts appeared in extensively disturbed areas or at the downslope margins of these sites where sandy deposits were generally thinnest. Temporally diagnostic points were collected from the surface. Overall, 41CV595 and 41CV988 appeared to be the most heavily damaged, then 41CV1411.

Twenty-six trenches and 32 test units were excavated at the three sites during the additional testing phase (Table 4.1). Trenches were dug using a Gradall or a backhoe the Department of Public Works (DPW) at Fort Hood provided, and extremely proficient DPW staff operated them. The project archeologist determined trench placement and monitored all trenching. The trenches were located in areas where the potential for buried cultural deposits was considered high based on past investigations and present observations. The trenches varied

Table 4.1. Summary of additional testing

Site	No. of Gradall Trenches	No. of Backhoe Trenches	No. of Test Units
41CV595	1	8	10
41CV988	4	–	10
41CV1141	–	13	12
Total	5	21	32

greatly in orientation, length, and depth, but each measured one width of each machine's bucket. Gradall trenches were 1.55 m wide, and backhoe trenches were 0.70 m wide. Once excavated, each trench was thoroughly inspected. Diagnostic artifacts and ground stones were collected either in situ or from backdirt piles. The mechanical excavations terminated at deposits bearing no cultural materials, either consisting of limestone bedrock, weathered (parent) Paluxy sandstone, or a clayey argillic horizon. Trenches were numbered consecutively and incorporated the sequence from previous investigations to avoid redundancy. A numbered wooden datum stake was placed next to the corresponding trench. The project archeologist noted trench locations on the site sketch map and recorded geomorphic observations and descriptions of cultural remains on a trench data form for each machine-dug trench. Trench orientation was recorded as the direction of the long axis in relation to magnetic north, and dimensions were recorded in meters. A geomorphologist profiled selected trench walls and described strata on a geologic profile form. When stratigraphic profiles were similar, only one or two profiles were recorded. Specific information about methods used to describe geologic profiles is found in Appendix A.

Before hand excavations were conducted, a datum was established near the upslope margin of each site. Each primary datum was designated N1000 E1000 and assigned an arbitrary elevation of 100 m. All site mapping was done using an electronic total station (Sokkia SET 5F), and all excavation provenience information relates to this datum. Thus, all test units were on exact northing and easting grid coordinates and laid out at even meter intervals. Test unit designations were defined as the grid coordinate of the northwest corner of each unit (e.g., N1006/E1009). Most of the test units measured 1x1 m, but some units near backhoe trenches were slightly smaller. All depths corresponded to arbitrary elevations in relation to the datum, and excavation levels were set at even 10 cm increments. Vertical control was maintained by one of three methods: the electronic total station, a Pro Shot L2+ laser level, or line levels on wooden stakes with known elevation points.

The project archeologist determined locations of test units, at times consulting with the project manager and considering trenching results and previous investigations. Any obviously disturbed or imported deposits were removed as overburden and not screened; otherwise, all matrix was dry-screened through 1/4-inch-mesh hardware cloth. All cultural materials—excluding unmodified mussel shell fragments lacking hinges (presence noted), burned rocks (size-sorted, counted, and weighed), and intrusive historic and modern items (noted)—were collected. When found in situ, diagnostic artifacts and large pieces of charred wood were point provenienced and collected. A sample of land snail shells, up to a maximum of 15, also was recovered from each general level context and each feature in which they were present. An Excavation Record form was completed for each level, and Artifact Frequency Distribution Summary and Inventory of Field Bags forms were filled out for every test unit. Selected test unit profiles, particularly those revealing features or cultural lenses in cross section, were drawn, and a few were described by the geomorphologist. General Data forms were used for additional excavation information or daily notes.

All cultural features were numbered consecutively as they were encountered, and previously recorded features were included in the sequence to avoid confusion. Small, distinct features, such as pits or stains, were removed as discrete units, but nonfeature matrix surrounding the feature was removed according to arbitrary levels and screened separately. Large features such as the burned rock mound at 41CV595 were excavated using 10-cm levels. A feature data form was completed for each feature, and a plan view and profile were drawn. Whenever possible, point provenienced charcoal samples were taken. In many cases, all of the feature's matrix was removed as a flotation sample. The size of the flotation samples varied according to the feature's size and type of fill. If only a portion of the feature was sampled, the remaining matrix was screened through 1/4-inch mesh hardware.

Samples of burned rock, charcoal, and flotation (sediment) were taken from feature and general level contexts. Samples in each of the three categories were given a specific sample number consisting of the first letter of the sample type followed by a number (e.g., BR1 for a burned rock sample). Within each sample type, succeeding samples were numbered sequentially as they were collected. The detailed provenience and contextual data for all samples was recorded on an Inventory of Samples Collected form.

The investigations at each site were photographed and videotaped. Black-and-white print and color slide photographs were taken to document all phases of the investigations, including site and area overviews, trench and test unit profiles, cultural features, and general excavation progress. Videotape recording all phases of work provided added documentation.

On 15 August 2000, a letter report submitted to the Contracting Officer's Representative summarized the additional testing results. This interim report described the excavations and findings for each site, presented a list of Paluxy site research questions, and recommended that 41CV595 be selected for data recovery. On 17 August 2000, the Contracting Officer's Representative concurred with the recommendations and granted permission to proceed with data recovery at 41CV595. All of the test excavations at 41CV988 and 41CV1141 were backfilled, as were several of the trenches at 41CV595. Some of the trenches and all of the hand-dug units at 41CV595 were left open for the data recovery phase.

DATA RECOVERY

Data recovery was done only at 41CV595 and consisted of hand excavation of 57 more test units between 17 August and 26 September 2000. This work brought the total number of units excavated at this site to 67, and no more mechanical work was done during this phase. For the data recovery, three separate areas of the site were defined and designated as Areas 1 through 3, but most of the work was targeted to concentrate in Areas 2 and 3. Within these three areas, overall excavation, additional testing and data recovery combined were:

Area 1	3 test units, 1 backhoe trench
Area 2	45 test units, 1 backhoe trench
Area 3	19 test units, 1 backhoe trench

The excavation methods and provenience control procedures instituted during the additional testing were followed during data recovery, and each test unit was designated according to the grid coordinate of its northwest corner. All of the hand-dug test units measured 1x1 m, except for one unit adjoining a backhoe trench that was somewhat larger. Pollen and phytolith samples were also collected during this phase of fieldwork.

All of the excavations were backfilled on 26 September 2000. Before the excavations were backfilled, plastic was placed on the floors of most units, and rebar was pounded into seven corners of the main excavation block in Area 2. To facilitate data analysis and presentation, all test units at each site were assigned sequential test unit numbers in geographic order within areas. For example, the test unit designated as N1006/E1009 in the field was reassigned the designation Test Unit 9, and all of the contiguous test units in the Area 2 excavation block were designated as Test Units 8 through 52 (from the north to south, and east to west). All field and lab records are labeled with the original grid coordinate designations and corresponding test unit numbers, but discussions throughout the remainder of this report use only the reassigned test unit numbers (a key linking test unit numbers to grid coordinates is presented in Chapter 7). As with the trenches and features, the sequence of test unit numbers includes all previous hand excavations to avoid any number duplication.

LABORATORY METHODS

Before fieldwork began, the methods and standards the Fort Hood Cultural Resources Management Program required for laboratory processing and curation of collections were reviewed thoroughly. Artifact and material collections also were processed and curated according to current federal curation guidelines and Council of Texas Archeologists standards. A Laboratory Manual outlining the procedures and standards that were followed was created.

All collections were organized, processed, and curated by site. Collections from different sites were not intermingled at any stage of processing. As artifacts and samples were brought in from the field, they were organized by provenience and checked against the inventory of field bags and the sample inventory form completed in the field for any problems or inconsistencies with the provenience information. If a problem was noted, it was corrected by referring to other excavation records or by consulting with the field supervisor. Collection bags were also checked for special information or instructions, and these materials were handled accordingly.

Once the field bags were checked, the materials were taken to the wet lab for cleaning. Some artifact categories such as bone, charcoal, and vegetal matter were finger- or dry-brushed rather than being cleaned with water. Other artifacts were cleaned using tap water and occasionally a soft toothbrush. After cleaning, artifacts were placed on a drying rack and allowed to air dry thoroughly before being cataloged.

After cleaning, the artifacts were bagged by material type within provenience designation. Each group of provenienced artifacts was assigned a unique provenience-specific accession number. Organized by site and in accession number order, a specimen inventory was compiled with each artifact type listed under its assigned accession number. Recorded on the specimen inventory were the accession number, associated provenience data, the name of the excavator(s), the date of excavation, any other information recorded on the field bag, and the type and quantity of artifacts recovered. For some material categories like charcoal, a weight (usually in grams) was recorded rather than a count.

All categories of artifacts were cataloged with site and accession numbers. Lithic tools were assigned unique specimen numbers within each accession number. When assigned, this number was added after the accession number on the artifact. Artifacts received a base coat of Acryloid B-72 (a 10 percent solution of Acryloid B-72 in acetone). When the artifact was dry, the site, accession, and specimen numbers were recorded using a rapidograph pen with archival black or white ink. This catalog number was then covered with a top coat of Acryloid B-72.

After grouping, each artifact type or class was placed into an appropriately sized 4-mil polyethylene bag. Archival curation tags documenting the name of the project, project number and date, site number, provenience data, accession number, artifact type, and the number of specimens (or weight) were placed into 1.5-mil polyethylene bags and placed within each artifact bag. Artifacts were grouped by artifact types or subtypes if appropriate. For example, projectile points were bagged by type name rather than as one unit.

Flotation samples were processed using the Flote-Tech flotation system, which provides a multimodal method of separating materials in a sediment sample. The process resulted in a light fraction that was used for special analyses (such as macrobotanical) and a heavy fraction that was checked for artifacts larger than 1/4 inch. Roots and unmodified rocks were removed and discarded. Any artifacts found in flotation samples were processed following the procedures outlined above.

One pollen wash, following procedures that Dr. John G. Jones (Palynology Laboratory, Texas A&M University) described, was taken from the grinding basin of a complete metate from 41CV595. First, loose dirt was carefully brushed off the grinding surface with a soft, clean toothbrush. The grinding surface was then flooded with a small amount of distilled water—enough to cover the grinding surface but not get onto the rest of the metate. Next, the ground area was gently scrubbed with a soft, clean toothbrush, and the water was collected into a clean glass jar. This procedure was repeated three more times using a 10 percent hydrochloric acid and distilled water solution. After each wash, the solution was placed in the glass jar. A final wash was done with distilled water, and this was also collected. After the pollen washes were complete, the metate was washed with tap water.

Once he received the metate, Dr. Jones conducted a conservative extraction procedure on the wash sample. The sample was screened through 150-micron mesh, and two *Lycopodium* spp. tracer spore tablets (13,500 spores/tablet) were added. These readily recognizable, exotic spores served to verify that analyst error was not a factor if there was no fossil pollen. After the tracer spores were added, the samples were washed in dilute hydrochloric acid to remove carbonates and dissolve the binder in the spore tablets. Next, the samples were concentrated and washed with 50 percent hydroflouric acid and 1 percent potassium hydroxide to remove silicates and humates. The samples were rinsed in distilled water and concentrated, then subjected to an acetolysis treatment to remove unwanted organic materials. Pollen and charcoal were concentrated with a heavy density separation of zinc bromide (specific gravity of 2.00). The samples were stained and transferred to glycerine for curation. A single drop of residue was permanently mounted on a microslide and examined at 400x on a Jenaval compound stereomicroscope.

A second special study also was conducted on the complete metate from 41CV595. A small block of the limestone was cut from the central portion of the metate's basin using a drill with a cutting drill bit. The sample approximated a 3.5-cm cube but tapered toward its bottom to facilitate removal (i.e., an inverted flat-topped pyramid). The sample was sent to Dr. Mary Malainey (Department of Native Studies, Brandon University, Manitoba, Canada) for organic residue analysis.

Photographic materials also were organized by site. Black-and-white photographs and negatives were checked against the photo logs to ensure that frame numbers and captions correlated and that the recorded information was accurate. The contact sheets were labeled on the back with project, site, and photo numbers. A 3x5-inch print was made from each negative, and these also were labeled with project, site, and photo numbers, as well as captions. Color slides were checked against the photo log to ensure that the frame numbers and captions correlated and that the recorded information was accurate. Each slide was labeled with project name and number, site number, slide number, and caption. All of the photographic materials were placed into the appropriate archival holders. Videotapes of site investigations were labeled with project name and number, site number, and appropriate provenience information.

All forms and records used in the field, the lab, and during analysis were printed on archival paper and filled out in pencil. The exceptions were maps drawn on nonarchival grid paper, which were later treated in the lab with a deacidification solution. All field, lab, and analysis records were organized by project and then by site. Records were grouped by categories such as daily journal notes, testing forms, feature forms, specimen inventories, and so on, but all photographs were curated as a unit, with all of the black-and-white photographs together and all of the color slides together. All written and photographic materials were placed in archival folders, archival record boxes, and archival curation boxes. An inventory detailing contents was included with each curation box. Curated photographic records also contain a computer-generated copy of the photo log, a cross-referenced photo log organized by site, and a disk copy of the computerized photo logs.

ANALYTICAL METHODS

The material culture classification scheme employed during this analysis is outlined in Table 4.2. Artifacts were grouped first by type of material, and within each material group, artifacts were further classified into morphological and functional classes and subclasses. Systematic observations of selected attributes were defined for different classes of artifacts. Each specimen was analyzed individually, and its specific attribute data were recorded on a computer coding form and entered into the computer database (see Data Manipulation below). The detailed attributes recorded for stone artifacts, the most abundant artifact type recovered, are summarized in Table 4.3. The rest of this section defines the various artifact classes and recorded attributes.

Various studies were conducted on samples and cultural materials, and independent consultants performed some specialized technical analyses—radiocarbon assays, analysis of unmodified faunal remains, and macrobotanical, pollen, and organic residue analyses. The methods and results of these special studies are reported in separate appendices or in appropriate chapters.

Definitions of Artifact Classes

The artifact classification and attribute analysis systems are the same as those Prewitt and Associates used for all prehistoric site testing from 1996 to 2001 (Kleinbach et al. 1999; Mehalchick et al. 2001; Mehalchick, Killian et al. 2000; Mehalchick, Kleinbach et al. 2000). They also generally correspond with the artifact analyses TRC Mariah conducted previously (Abbott and Trierweiler 1995a:56–68; Trierweiler 1996:54–63) and with general morphological descriptions of chipped and ground stone artifacts by Turner and Hester (1993).

Stone Artifacts

Arrow and dart points are functional groupings that denote stone artifacts probably used to tip projectiles. They are generally characterized as bifacially (sometimes unifacially) flaked specimens with triangular to leaf-shaped blade sections, sharply pointed distal ends, and sharp lateral blade edges. The distinction between arrow and dart points is one of size, with arrow points generally having a smaller blade and neck (or stem) width (the latter generally less than 8 mm for arrow points). When possible, arrow

Table 4.2. Classification of material culture

CHIPPED STONES	GROUND AND BATTERED STONES
• Arrow points	• Manos
named types	• Metates
untyped	• Mano-hammerstones
untypeable (fragments)	• Hammerstones
preforms	• Other ground stones
• Dart points	• Indeterminate ground stone fragments
named types	
untyped	
untypeable (fragments)	OTHER STONE ARTIFACTS
preforms	
• Unidentified Projectile Points	MODIFIED BONES
• Perforators	
• Gouges	MODIFIED SHELLS
unifacial	
bifacial	UNMODIFIED BONES
• Bifaces	
early- to middle-stage	UNMODIFIED SHELLS
late-stage to finished	
miscellaneous	MACROBOTANICAL REMAINS
knives	
beveled knives	
• Unifaces	
end scrapers	
side scrapers	
end-side scrapers	
other scrapers	
miscellaneous	
spokeshaves	
• Cobble tools-choppers	
• Gravers	
• Burins	
• Core tools	
• Multifunctional tools	
• Edge-modified flakes	
• Cores	
• Tested cobbles	
• Unmodified debitage	

and dart points were further classified by named types defined in archeological literature. Specimens that could not be assigned to a named type are classified as untyped–that is, complete or nearly complete points that do not conform to any specific type—but untypeable fragments are points that are too incomplete to be typed. Chris Ringstaff assigned all projectile points to types. Preforms consist of unfinished arrow and dart points and include specimens at various stages of reduction.

Perforators are characterized as having relatively long and tapered projecting bits with diamond-shaped biconvex or planoconvex transverse cross sections. They generally show use-related microflaking on both faces of each edge or on alternate faces of opposite edges. Polish and rounding are often evident as well. The bases of perforators may be unmodified flakes, unifaces, bifaces, or projectile points reworked into perforators. As a functional group, perforators are thought to have been used primarily for drilling or poking holes through various materials. Perforators may include fine-tipped specimens, commonly called drills, and broad-tipped specimens, often called reamers.

Gouges are triangular or trapezoidal specimens with planoconvex transverse and longitudinal cross sections. They may be unifacially or bifacially flaked but have straight to concave,

Table 4.3. Summary of attributes recorded for stone artifacts

Attributes Recorded	Projectile points and preforms	Unmodified debitage	Chipped stone tools	Ground stone tools
Type name	x	–	–	–
Tool class or subclass	x	–	x	x
Raw material	x	x	x	x
Completeness	x	x	x	x
Total cortex	–	–	x	–
Flake cortex	–	x	–	–
Heating	x	x	x	x
Maximum length	x	–	x	x
Maximum width	–	–	x	x
Maximum thickness	x	–	x	x
Blade length (mm)	x	–	–	–
Blade width (mm)	x	–	–	–
Haft length (mm)	x	–	–	–
Neck width (mm)	x	–	–	–
Base width (mm)	x	–	–	–
Comments	x	x	x	x

steeply beveled working edges. Use polish and microflaking are concentrated primarily on the tool's ventral face. Use-wear studies indicate that some gouges were probably hafted tools that functioned much like modern-day planes or adzes. As used in this analysis, gouges also include tools that some lithic analysts classify as wedges. Some of the Fort Hood specimens conform to the Clear Fork varieties (unifacial and bifacial) of gouges Turner and Hester defined (1993:246–249).

Bifaces include all varieties of bifacially flaked tools that are not included in other classes. Bifaces are grouped into the three subclasses that Mariah archeologists (Abbott and Trierweiler 1995a:60–61; Trierweiler 1996:56–57) used: early- to middle-stage bifaces, late-stage to finished bifaces, and miscellaneous bifaces. The first two subclasses represent different stages of the biface reduction sequence Callahan (1979), Collins (1975), Sharrock (1966), and others recognized. Early- to middle-stage bifaces approximate Callahan's Stages 2 and 3, Collins's initial trimming into primary trimming, and Sharrock's Stages 1 and 2. They have moderate to considerable amounts of cortex remaining and may have isolated knots resulting from inadequate flake removals. The edges are irregular and show no clear central plane when viewed on end.

Late-stage to finished bifaces approximate Callahan's Stages 4 and 5, Collins's primary trimming into secondary trimming, and Sharrock's Stages 3 and 4. They are characterized by few or no remnants of cortex, sinuous to straight edges centered on a longitudinal plane when viewed on end, and a well-defined outline shape. Some of the Fort Hood late-stage to finished bifaces conform to named types of tools such as the Friday, Guadalupe, or San Gabriel bifaces Turner and Hester described (1993:253, 256–258, 273). Finished bifaces generally have a clear ovate to triangular outline shape. The miscellaneous biface subclass is a catchall group that includes bifacially worked specimens too fragmentary or too irregular to be classified as early- to middle-stage or late-stage to finished bifaces. Miscellaneous bifaces may include specimens that functioned as scrapers or knives, or in other capacities.

Knives are finished bifaces that show use wear and sometimes haft wear. They are identified by their morphology and wear, and the implied function is that of sawing or cutting. Beveled knives are thin bifaces that were ovate when manufactured, but one or both ends are pointed because alternate blade edges were sharpened.

Unifacial specimens are classified into six subclasses as follows: end scrapers, side scrapers, end-side scrapers, other scrapers, miscellaneous unifaces, and spokeshaves. These subclasses are recognized by the morphology and location of unifacial retouch or use wear compared to the flake on which the tool is made. End scrapers have significant retouch and use wear along their distal edges, side scrapers have one or more worked and worn lateral edges, and combination end-side scrapers have characteristics of both. These scrapers, particularly end scrapers, may show evidence of hafting in the form of scarring or polishing on ventral ridges or proximal lateral edges.

Other scrapers are unifacially worked implements with two or more retouched working edges that do not conform to the standard morphology of the end, side, or end-side scraper subclasses (e.g., a round scraper with its entire circumference serving as a working edge). Miscellaneous uniface is the catchall group for any unifacial tool that does not fit into another subclass. Miscellaneous unifaces include specimens that are irregularly shaped or have minimal unifacial working and retouch. Spokeshaves are small flake tools with a worked concave edge that may have functioned as a plane to shave wood off of round sticks or shafts. The notchlike indentation may have been produced bifacially or unifacially.

Cobble tools-choppers are unifacially or bifacially flaked implements made on cobbles or pebbles. Cobble tools show extensive step fracturing, edge rounding, and polish indicating heavy wear. Large cobble tools are often called choppers and were probably used as hammers for heavy battering and crushing.

Gravers and burins are flake tools with one or more carefully chipped beaklike protrusions. They probably represent specialized tools used for fine cutting and engraving. Unifacial and bifacial tools with graver tips are classified as multifunctional tools. Burins probably functioned much like gravers (i.e., for cutting and engraving) but were made by striking off a flake so that it ran along a flake or tool edge. This different technique leaves a very strong steep, or right-angle, edge where the flake was removed.

Core tools are cores (see below) that have had one or more edges subsequently modified, either intentionally prepared as a working edge or altered through use. These tools are likely cores that were picked up and used as scraping or battering tools. The primary distinction between core tools and cobble tools is that the former originally functioned as cores before being made into or used as tools, but the latter did not.

Multifunctional tools are artifacts that appear to have been intentionally manufactured for and used to perform two or more functionally distinct tasks. Multifunctional tools may include artifacts that fall into two or more of the other artifact classes. For example, an end-side scraper with a spokeshave notch or graver beak would be classified as a multifunctional tool rather than as a spokeshave or graver.

Edge-modified flakes are flakes with one or more edges that exhibit very minimal retouch or use wear. These expedient tools were used with little or no preparation. Edge-modified flakes include tools that some lithic analysts call utilized flakes or minimally retouched flakes.

A core is a chipped stone that shows flake removals, and its primary function appears to have been as a source of flakes. Cores exhibit no evidence of use, and the original intent was to remove flakes suitable for producing tools. Tested cobbles are characterized by minimal flake removal and retain at least 90 percent of the cortex. These specimens are literally tested pieces to inspect the quality of the raw material.

Unmodified debitage consists of flakes that exhibit no evidence of having been further modified or used. For analytical purposes, unmodified flakes were classified as complete, proximal fragments, chips (medial or distal fragments), and chunks (angular fragments). Although the amount of cortex on flakes was recorded (see below), no attempt was made to define flakes according to their inferred reduction stage (such as biface thinning flakes, notching flakes, or unifacial manufacture and resharpening flakes). Before attributes were coded, unmodified flakes also were sorted into the following size categories corresponding to standard-sized sieves: <0.25 inch, 0.25–0.50 inch, 0.5–1.0 inch, 1.0–1.5 inches, 1.5–2.0 inches, and >2.0 inches.

Ground and Battered Stone Artifacts

Ground and battered stone tools are classified into the following groups: manos, metates, mano-hammerstones, hammerstones, other ground stones, and indeterminate fragments. Manos are stones used for grinding and generally have one or two ground faces (i.e., unifacial or bifacial grinding). Metates are milling slabs on which manos were used, and they encompass a range of different forms and sizes. Mano-hammerstones functioned primarily as manos but also show evidence of battering along one or more edges. Hammerstones exhibit extensive battering on one or more edges, and most are water-worn cobbles that often have heavy battering on their ends. The precise function of hammerstones is not always clear, but most specimens are thought to represent percussion hammers used in knapping other stone tools. Other ground stones can include a variety of tools such as anvils, abraders, pestles, nutting-pitted stones, and modified hematite. Indeterminate fragments are pieces of ground stone too fragmentary to identify their form or function.

Other Stone Artifacts

This artifact class consists of all other culturally modified lithic artifacts that could not be classified in any of the categories above.

Burned Rocks

Burned rocks were ubiquitous and found in almost every test unit excavated. They were quantified in the field and discarded unless they appeared to be modified or were specifically collected as samples. Quantification consisted of sorting the burned rocks into five size categories and then counting and weighing all specimens in each category. The size categories used for this project were < 5 cm, 5 to 15 cm, 15 to 25 cm, 25 to 35 cm, and > 35 cm. Burned rocks on the surface or in other exposures such as backhoe trenches or cutbanks were not quantified, but their presence was noted.

All of the burned rocks consisted of limestone and appeared to be local in origin. The only noticeable distinction was between fossiliferous and nonfossiliferous pieces. The fossiliferous typically fired pink to bright red, contained many fossils, and was the most common type, whereas the nonfossiliferous usually turned gray-bluish gray to dull red when burned and had few, if any, inclusions. Fossiliferous limestones occur near Paluxy sites in both the Walnut Clay (upslope) and Glen Rose (downslope) Formations.

Modified Faunal Remains

Modified bones are specimens purposefully cut, ground, or otherwise altered in manufacturing a tool or ornament. This category may also include specimens that show use wear and were used as tools. Mussel valves or shell fragments showing intentional modification such as cut edges or drilled holes were used as tools and ornaments.

Unmodified Faunal Remains

Unmodified faunal remains include vertebrate and invertebrate materials. Depending on their archeological context and other factors, unmodified bones are considered to represent either discarded remains of animals that were killed by humans or remains that were deposited in sites through natural processes. Unmodified bones are specimens that show no evidence of intentional modification but may include bones that were modified incidentally or accidentally by humans. These modifications (e.g., bones that exhibit spiral fractures or cut marks from butchering an animal) are often the result of human activities but are recorded as attributes of unmodified bones rather than as modified bones. Brian S. Shaffer analyzed faunal remains.

Invertebrate faunal remains include land snail shells and freshwater mussel shells, and Karen M. Gardner analyzed these to identify species and human modifications. Snail shells, primarily various species of *Rabdotus*, tend to be commonplace in cultural deposits at Fort Hood and are believed to occur naturally in most contexts. Organic-rich detritus in habitation sites likely attracted the snails. Consequently, the presence and abundance of snail shells was always noted in excavation records, but only a small sample was collected from any given provenience for possible radiocarbon dating or amino acid racemization studies.

Mussel shell valves and fragments also were abundant in several cultural deposits and are believed to represent materials humans introduced and discarded. All unmodified mussel shell valves with an umbo (whole or partial) were collected, but other unmodified fragments were discarded in the field. Discolored or calcined shells indicate that shells were heated intentionally, perhaps to remove the mussels, or burned accidentally, possibly being discarded into fires.

Macrobotanical Remains

Samples of macrobotanical remains, primarily charred wood and sediments (i.e., flotation samples), were taken from cultural sediments. The presence, absence, or abundance of macrobotanical remains are discussed for individual sites but were not entered into the artifact database. A detailed analysis of macrobotanical remains is presented in Appendix B.

Definitions of Stone Artifact Attributes

Aside from provenience data and classification attributes, other attributes recorded for stone artifacts consist of subjective observations and objective measurements of metric data (see Table 4.3). Subjective attributes include identifications of raw materials and chert types and assessments of artifact completeness, presence or absence of cortex and patination, and evidence of heating. Objective (i.e., metric) attributes consist of measurements (in millimeters) used to characterize individual specimens. When appropriate, comments on nonstandard attributes or observations for individual specimens were added to the database.

Raw Materials and Chert Types

Raw material types identified among the chipped, battered, and ground stone artifacts are chert, quartzite, limestone, sandstone, and hematite. Specimens identified as chert consist of opaque to partially translucent cryptocrystalline or microcrystalline materials. Fine-grained cherts lack visible crystalline structure, have weak to moderate luster, and are partially translucent. Coarse-grained cherts have visible crystalline structure, an opaque appearance, and a generally grainy fill.

Quartzites are metamorphic rocks consisting mainly of recrystallized quartz. Most recovered quartzite specimens are characterized by fine-grained crystalline structures and a reddish purple color. Various types of Cretaceous limestones (carbonate-rich, fine-grained sedimentary rocks) are the most abundant rocks found in cultural deposits at Fort Hood (see burned rocks). No attempt was made in the field or laboratory to sort types of limestones, but excavators noted the approximate frequencies of fossiliferous vs. nonfossiliferous limestones in many cultural features and sites. Some varieties of sandstone—fine- to coarse-textured sand grains cemented by silica or carbonates—are found in the Cretaceous limestone deposits in the Fort Hood area. Other types of sandstone appear to be nonlocal in origin. Hematite nodules—iron oxide concretions in advanced stages of weathering—occur naturally in certain localities (e.g., Paluxy sediments).

All chert specimens, regardless of artifact class, were compared with the established Fort Hood chert typology. Because central Texas is so important as a chert resource area for local and extra-regional use (Shaffer 1993:55), much attention has been devoted to developing a typology of the chert resources present on Fort Hood (Abbott and Trierweiler 1995b; Dickens 1993a, 1993b; Frederick and Ringstaff 1994). The Fort Hood chert typology that previous researchers established was used in this study and is summarized in Table 4.4. The lithic analyst conducted limited on- and off-site surveys to locate, sample, and describe chert resources in the immediate area of the site.

Completeness

Each stone artifact is described as complete, nearly complete, proximal fragment, medial fragment, distal fragment, edge fragment, indeterminate fragment, or barb. For incomplete specimens, no attempt was made to interpret the nature of the breakage (manufacture vs. use breaks).

Cortex

The amount of cortex present on a chipped stone artifact provides evidence of the raw material source and can reveal much about the stage of manufacture. Cortex on each chipped stone artifact was recorded as 0 percent, 0–50 percent, 50–99 percent, or 100 percent. No attempt was made to describe different types of cortex.

Patination

The degree of patination on chert artifacts was noted as being none, light, or heavy.

Table 4.4. Fort Hood chert types

Type No.	Type Name	Abbreviation	Chert Province*
1	Heiner Lake Blue-Light	HLB-LT	Southeast Range
2	Cowhouse White	CW	Southeast Range
3	Anderson Mountain Gray	AMG	West Fort
4	Seven Mile Mountain Novaculite	SMN	West Fort
5	Texas Novaculite	TN	North Fort
6	Heiner Lake Tan	HLT	Southeast Range
7	Fossiliferous Pale Brown	FPB	Southeast Range
8	Fort Hood Yellow	FHY	North Fort
9	Heiner Lake Translucent Brown	HLTB	Southeast Range
10	Heiner Lake Blue	HLB	Southeast Range
11	East Range Flat	ERF	North Fort
13*	East Range Flecked	ER FLECKED	Southeast Range
14	Fort Hood Gray	FHG	North Fort
15	Gray-Brown-Green	GBG	North Fort
16	Leona Park	LP	North Fort
17	Owl Creek Black	OCB	Cowhouse Alluvial
18	Cowhouse Two Tone	CTT	Cowhouse Alluvial
19	Cowhouse Dark Gray	CDG	Cowhouse Alluvial
20	Cowhouse Shell Hash	CSH	Cowhouse Alluvial
21	Cowhouse Light Gray	CLG	Cowhouse Alluvial
22	Cowhouse Mottled with Flecks	CMF	Cowhouse Alluvial
23	Cowhouse Banded and Mottled	CBM	Cowhouse Alluvial
24	Cowhouse Fossiliferous Light Brown	CFLB	Cowhouse Alluvial
25	Cowhouse Brown Flecked	CBF	Cowhouse Alluvial
26	Cowhouse Streaked	CS	Cowhouse Alluvial
27	Cowhouse Novaculite	CN	Cowhouse Alluvial
28	Table Rock Flat	TRF	West Fort
29	Indeterminate white	–	none
30	Indeterminate yellow	–	none
31	Indeterminate mottled	–	none
32	Indeterminate light gray	–	none
33	Indeterminate dark gray	–	none
34	Indeterminate light brown	–	none
35	Indeterminate dark brown	–	none
36	Indeterminate black	–	none
37	Indeterminate blue	–	none
38	Indeterminate red	–	none
39	Indeterminate nonlocal	–	none

Note: No Type 12 was assigned.

*Chert provinces defined by Trierweiler (1994: Figures 9.1 and G.1) and Abbott and Trierweiler (1995:697–734).

Patination is the complex weathering by which cherts develop a colored rind around their exterior surfaces. For central Texas cherts, Frederick et al. (1994:6) use the term patina to refer to the weathering rind that is visible in petrographic thin sections and is “white or light gray to the unaided eye.” Patination is time-dependent and can be used to indicate age with some sites, although the absence of patination says nothing about an artifact’s age. There are too many variables involved in the chemical process of patination to derive meaningful chronological interpretations based on variations in the degree of patina.

Heating

Artifacts that exhibit evidence of low- to moderate-intensity heating—such as slight discoloration, reddening, and a glossy surface texture—may have been intentionally heat treated. When artifacts were intensively heated—as shown by heat spalling, fracturing, or crazing—it is likely that the heating was accidental. But distinguishing between intentional and accidental heating is subjective.

For this analysis, degree of heating was recorded as none, low, or high for all stone artifacts. Most of the chert specimens that were heated show evidence of low- to moderate-intensity heating and are thought to represent intentionally heat-treated pieces. Previous experiments by Frederick and Ringstaff (1994:156-157) demonstrate that heating flakes up to temperatures of around to 550ºF significantly improves the workability of almost all of the Fort Hood cherts. This level of heating also causes significant changes in the luster or color of most of the cherts so that an experienced lithic analyst can determine heat alteration with great accuracy. It is an assumption, albeit a reasonable one, that chert specimens with a low to moderate degree of heating represent materials that were intentionally heat treated.

Metric Attributes

For most stone tools the only measurements taken were maximum length, width, and thickness. For projectile points the standard measurements taken were maximum length, blade length, blade width, haft width, neck width, base width, and maximum thickness. All measurements were taken in millimeters with digital calipers and read to one-hundredth of a millimeter.

INVESTIGATIONS AT 41CV988

Gemma Mehalchick, Christopher W. Ringstaff, and Karl W. Kibler

5

PREVIOUS INVESTIGATIONS

Survey

Frye, Mesrobian, and Dureka (Texas A&M University) recorded the site on 10 February 1986. Dense accumulations and scatters of burned rocks, as well as ground and chipped stone artifacts, were noted. None of the burned rock areas were formally designated as features, but one mound was depicted at the west-central site margin on the sketch map. The ground stone artifacts appeared to be associated with the burned rock areas. Two manos, a hammerstone, a biface, and two dart points were collected. Estimated site dimensions were 190x185 m, and vehicular traffic and erosion disturbed approximately 60 percent of the area. A portion of a historic homestead (41CV976) overlapped the northeastern site margin.

Reconnaissance Survey and National Register Testing

On 2 November 1992, Turpin and Frederick (Mariah Associates) visited and evaluated the site. Based on the extent of surficial cultural materials, the site dimensions were reduced to 125 m east-west by 80 m north-south. The site was situated on a flat to slightly convex slope formed across an outcrop of Paluxy sand. Soils exposed in many disturbed areas, rills, and trails were interpreted as alfisols exhibiting an A-AE-Bt soil profile in most places, although an A-C profile also was noted. The site was divided into Subareas A and B based solely on differing degrees of disturbance (Figure 5.1). Subarea A was generally defined as the deflated and eroded central portion of the site encompassing open areas that were heavily damaged by tanks and other vehicular traffic. The burned rock mound depicted on the 1986 site map was re-located within Subarea A and designated Feature 3. It measured 10 m in diameter and was reduced to two small burned rock concentrations from severe disturbance by vehicular traffic. Given the degree of disturbance to the deposits in Subarea A, no further work was recommended.

Subarea B consisted of two protected areas or islands of intact sediments near trees and other vegetation. These sections had the potential to contain shallowly buried cultural deposits. Two features were identified where burned rock scatters were previously noted. Feature 1 was mapped as a 40x20-m, surficially disturbed burned rock concentration situated in the south-central portion of the site. Along the eastern edge of the site, Feature 2 was a 50x18-m burned rock scatter with internal concentrations. Erosion, vehicular traffic, and construction activities had disturbed this feature. Because there was potential for subsurface cultural deposits, shovel testing was recommended for Subarea B.

On 7 December 1992, a Mariah Associates crew excavated 15 shovel tests in and near Subarea B (one shovel test was actually in Subarea A) to a depth of 40 cm or less. Seven shovel tests in the southern portion of the subarea produced 185 burned rocks, 14 flakes, and charcoal. Shovel tests in the northern section were culturally sterile. Results indicated that the south half of Subarea B might contain intact archeological deposits. Recommended testing to determine National Register eligibility consisted of a minimum of 3 to 4 m^2 of manually excavated test units (Trierweiler, ed. 1994:A1,133–A1,135).

Prewitt and Associates conducted National Register-eligibility testing at 41CV988 in

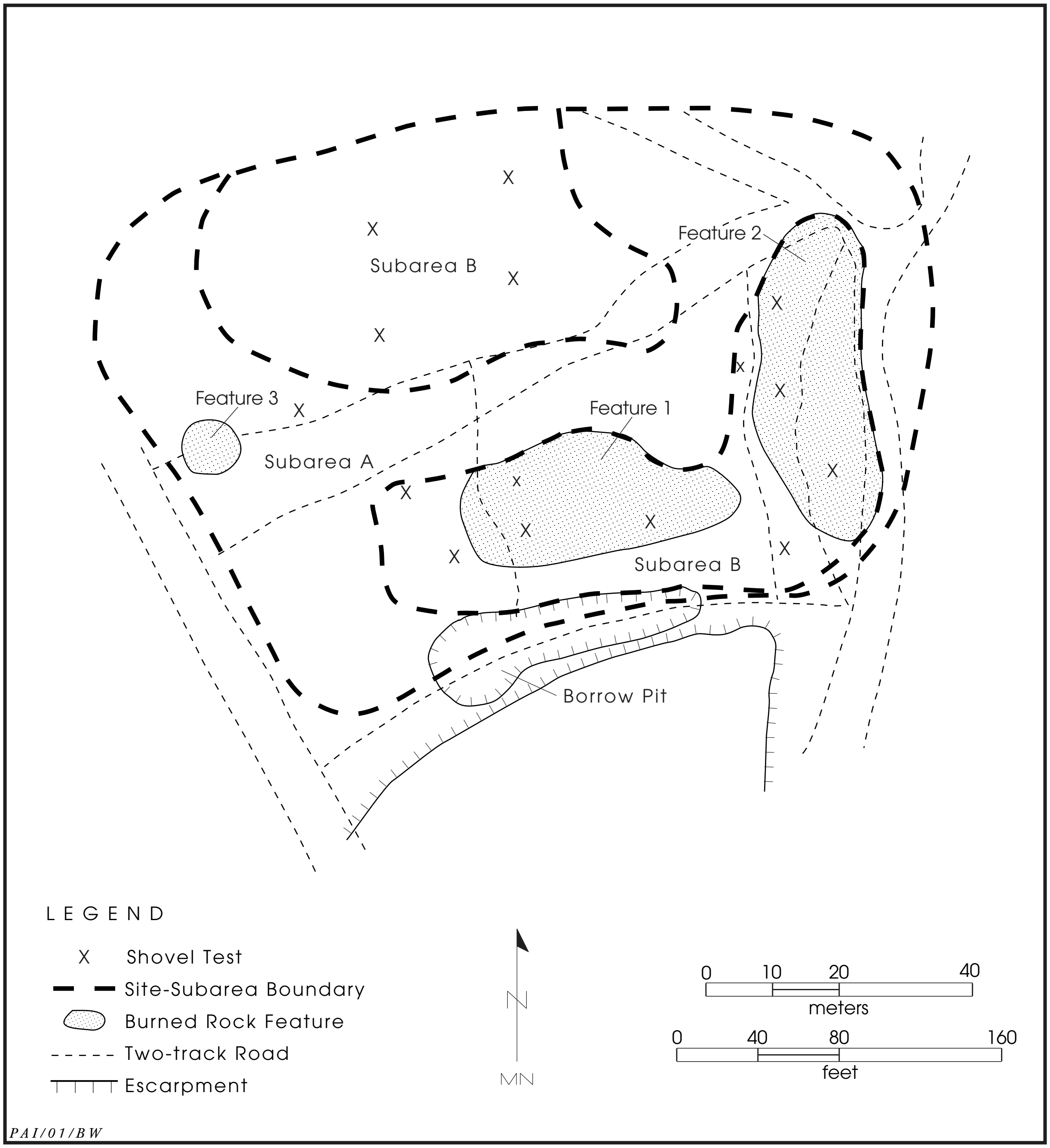


Figure 5.1. Site map of 41CV988 by Mariah Associates (modified from Trierweiler, ed. 1994:A1134).

September 1996 (Kleinbach et al. 1999:71–79). The National Register testing was confined primarily to the southeastern portion of the site (Figure 5.2), in the area where Feature 2 previously had been observed. Formal testing consisted of eight test units (Test Units 1–8), with a total of 3.75 m^3 manually excavated. Based on exposed cultural materials and testing results, maximum site dimensions were redefined as 135 m north-south by 115 m east-west. Although the test units were generally concentrated in an area that had been designated as Subarea A, the field investigations revealed that the distinction between Subareas A and B was not warranted. This distinction was based on perceived differences in the degree of disturbance (unlike subarea designations at most other sites that are based on geomorphic distinctions), but it was a

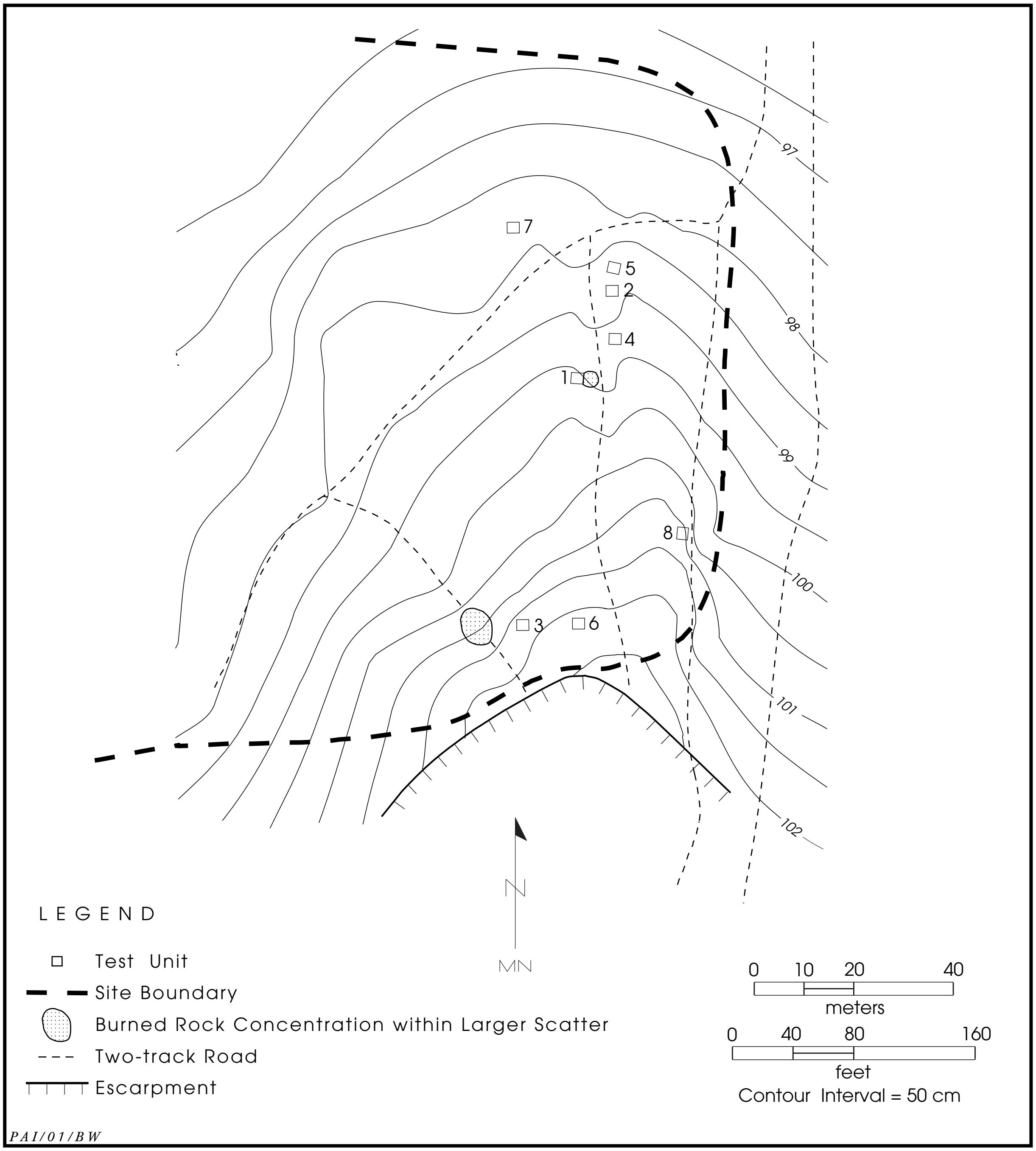


Figure 5.2. Map of southeast portion of 41CV988.

subjective assessment supported only by surface observations. The subsurface archeological data from the previous shovel testing and this round of National Register testing do not accurately define what areas are, or are not, disturbed. As a result, the subarea distinctions were dropped from consideration during this phase of testing.

Profiles of Test Units 1, 3, and 7 typified the stratigraphy of the eastern portion of the site and probably the whole site. The profile of Test Unit 1 consisted of a 12-cm-thick late Holocene brown to dark brown loamy fine sand (A horizon). This upper deposit rested on a truncated, reddish brown 2Bt horizon (12–25+ cm) formed in a late Pleistocene to early Holocene colluvial deposit. Upslope in Test Unit 3, the late Holocene colluvial mantle was 53 cm thick and underlain by weathered, white, fine-grained Paluxy sandstone. The late Holocene mantle exhibited a dark grayish brown A horizon over a brown to dark brown E horizon. The late Holocene colluvial mantle observed downslope in the profile of Test Unit 7 was a 37-cm-thick, cumulic A1-A2 profile. Beneath this soil was a truncated reddish brown clay loam soil (2Bt horizon) formed in late Pleistocene to Holocene colluvium.

Cultural materials recovered from the site consisted of 9 dart points (including Darl, Edgewood, and Ensor), 1 biface, 1 burin (recycled Pedernales dart point), 5 edge-modified flakes, 1 mano-hammerstone, 527 flakes, and 7 unmodified bones. The presence of recent or modern items, including one domestic pig bone, indicated that the upper 20 to 30 cm of deposits were disturbed in five of the eight test units. Six of the excavations contained varying quantities of burned rocks, and although shallowly buried, two intact hearths were encountered, Feature 2A in Test Unit 1 and Feature 4 in Test Unit 8.

Of the three previously recorded features, only two were re-located. Feature 3 was not found, but Features 1 and 2 were observed as large and diffuse burned rock scatters with some areas of concentrated burned rocks. The limits of the diffuse scatters appeared to be the same as observed in 1992 and were not mapped. The two most prominent burned rock concentrations were observed in tank trails and were mapped as an 8x5-m cluster on the western edge of Feature 1 and a 3x3-m cluster on the western edge of Feature 2. Further investigation demonstrated that the 3x3-m cluster was related to a disturbed hearth (designated as Feature 2A) in Test Unit 1.

Feature 2A, a basin-shaped hearth with maximum excavated dimensions of 1.0 m north-south by 1.1 m east-west, was present at 9–43 cm in Test Unit 1. Although an unknown portion of the feature was destroyed by the adjacent tank trail, the estimated diameter of the complete hearth is 1.75 m.

The feature consisted of a roughly circular cluster of five layers of burned rocks (n = 380, 172.25 kg). Charcoal collected near the base of the feature at 37 cm yielded a radiocarbon age of 1280 ± 40 B.P., and charred oak wood and indeterminate corm fragments were identified in a flotation sample. The corm fragments were pieces of charred plant root that most likely represent some type of geophytic plant (Dering 1999c:544).

Feature 4 was encountered at 19–41 cm in Test Unit 8 and consisted of another circular, basin-shaped hearth. The feature was entirely contained within the excavation, measured 50 cm east-west by 40 cm north-south, and was composed of a single layer of 77 pieces of tabular burned limestone (27 kg). A radiocarbon age of 1230 ± 40 B.P. was obtained on charcoal collected at 27 cm. Charred macrobotanical remains from one flotation sample consisted of oak, holly, and indeterminate wood.

The chronometric data and diagnostic artifacts revealed use of the area near the end of the Late Archaic period and possibly during the transition into the Late Prehistoric period. Discrete cooking features yielding charred wood and edible plant remains that indicate this site could provide valuable subsistence information. But the shallow components were also extremely susceptible to damage from vehicular traffic (particularly tanks) and erosion, which were noted as primary disturbances since the site was first recorded in 1986. Based on the testing results, 41CV988 was recommended as eligible for listing in the National Register.

Damage Assessment and Site Evaluation

After learning that sites were being damaged by cedar clearing activities in March 1998, Huckerby (Fort Hood) and Kleinbach (Prewitt and Associates) visited three sites to assess the extent of disturbances (Huckerby 1998a). All three sites, including 41CV988, were disturbed by heavy machinery. At 41CV988, juniper trees were removed from islands where there were oak mottes along a tank trail near the eastern site margin and in the southern portion of the site. Erosion and gullies were noted on or near these damaged areas, particularly along one edge of the east island where the deepest gully had formed. Bulldozer and tank tracks were observed across most of the site area, and some tracks created ruts up to 30 cm deep. Based on these observations, it appeared that tree clearing contributed to but was not the major source of site damage. Tank traffic that occurred after tree removal had caused the greatest amount of damage. Because the disturbance was not ubiquitous, it was thought that much of the subsurface materials might still be intact. "To protect the sub-surface deposits from additional track vehicle and erosional impacts, native seeds shall be placed over the eroded areas. Removed tree debris will be used to cut off the tracks through the site," (Huckerby 1998a:9).

From August 1998 through March 1999, archeologists from the Fort Hood Cultural Resources Management Office revisited all of the 165 archeological sites situated within the training areas where tree clearing had been done (i.e., Training Areas 30–36, 41–45, and 48). The goals of this study were to identify sites that were damaged by the tree clearing and to assess and quantify the amount of disturbance that had occurred at each site (Kleinbach 1999). In reassessing 41CV988, it was discovered that slightly more than half of the site was disturbed by the vegetation clearing activity. Within the damaged portions of the site, the upper 15 to 30 cm of deposits were disturbed where trees had been uprooted. Although tree clearing did not affect the central and outer portions of the site, tank traffic severely damaged these areas. The management recommendation stated that "data recovery should be implemented on a number of Paluxy sites" but noted that "the context of the cultural deposits at this site has been virtually destroyed, and it should be excluded from being considered for mitigation" (Kleinbach 1999:12).

WORK ACCOMPLISHED

Further testing of 41CV988 was initiated because of the damage to Paluxy sites (see Chapter 1). The current investigation was conducted from 19 to 27 July 2000. The site area was reinspected before excavations began. Because disturbances from tree clearing activities and recent tank traffic were extensive, only three (Test Units 3, 4, and 8) of the eight previously excavated test units were re-located. A general scatter of burned rocks and sparse debitage was noted in the vicinity of Feature 1. One Marcos and one Castroville dart point were collected from the surface.

Mechanical and manual excavations conducted at 41CV988 consisted of 4 Gradall trenches and 10 test units in the eastern half of the site (Figure 5.3). The 4 trenches measured 1.55 m wide and were excavated just east and west of the main north-south tank trail in areas that appeared likely to contain buried, intact cultural deposits. All of the trenches were dug until the clayey argillic Bt horizon (top of Stratum II, see Chapter 2) or weathered Paluxy sandstone was encountered. Gradall Trench 1 was placed near the south (upslope) site margin and within an island of oak trees. The long axis of this trench was oriented east-west and measured 20.5 m in length. Two other trenches were 6 to 10 m long and excavated perpendicular to the south wall of the long axis. Gradall Trench 1 was dug to a maximum depth of 1.1 m and exposed an occasional burned rock from the surface to 15 cm. Gradall Trench 2 was situated north of Feature 1 and west of Feature 2, but no cultural materials were observed. This T-shaped trench measured 20.5 m east-west and 24.5 m north-south. Although the deposits were up to 0.80 m thick in places, the trench averaged 0.20 to 0.30 m deep. Gradall Trench 3 was excavated about 18 m north-northwest (downslope) of where Feature 4 was found in Test Unit 8. The trench measured almost 15 m long but was only 0.25 m deep. There was a possible burned rock feature (later designated Feature 5) at ca. 20–22 cm near the northeast end of the trench. Gradall Trench 4 (5.25x1.55 m) was excavated to 40 cm about 4 m north of Gradall Trench 3. No cultural materials were observed in Gradall Trench 4, but modern ash lenses and charcoal, apparently from recent episodes of brush burning, were exposed at 20 cm in the north wall of the trench.

Hand excavations were confined primarily to the eastern portion of the site. Previous investigations and the Gradall trench exposures indicated this area had the thickest sediments and best potential to contain intact buried cultural deposits. Further testing consisted of ten 1x1-m test units (Test Units 9–18), with a total volume of 7.45 m^3 manually excavated in these areas (Table 5.1).

Each test unit was terminated when the clayey argillic (Bt) horizon (or Stratum II, see Chapter 2) or weathered Paluxy sandstone was encountered. Test Unit 9 was located at the downslope end of the site, north of Gradall Trench 4 and east of the old test unit. Test Units 10–13 were contiguous units placed where Feature 5 was exposed in the north end of Gradall Trench 3. These five excavations were relatively shallow, ranging from 25 to 55 cm thick. In the vicinity of Test Unit 8 and Feature 4

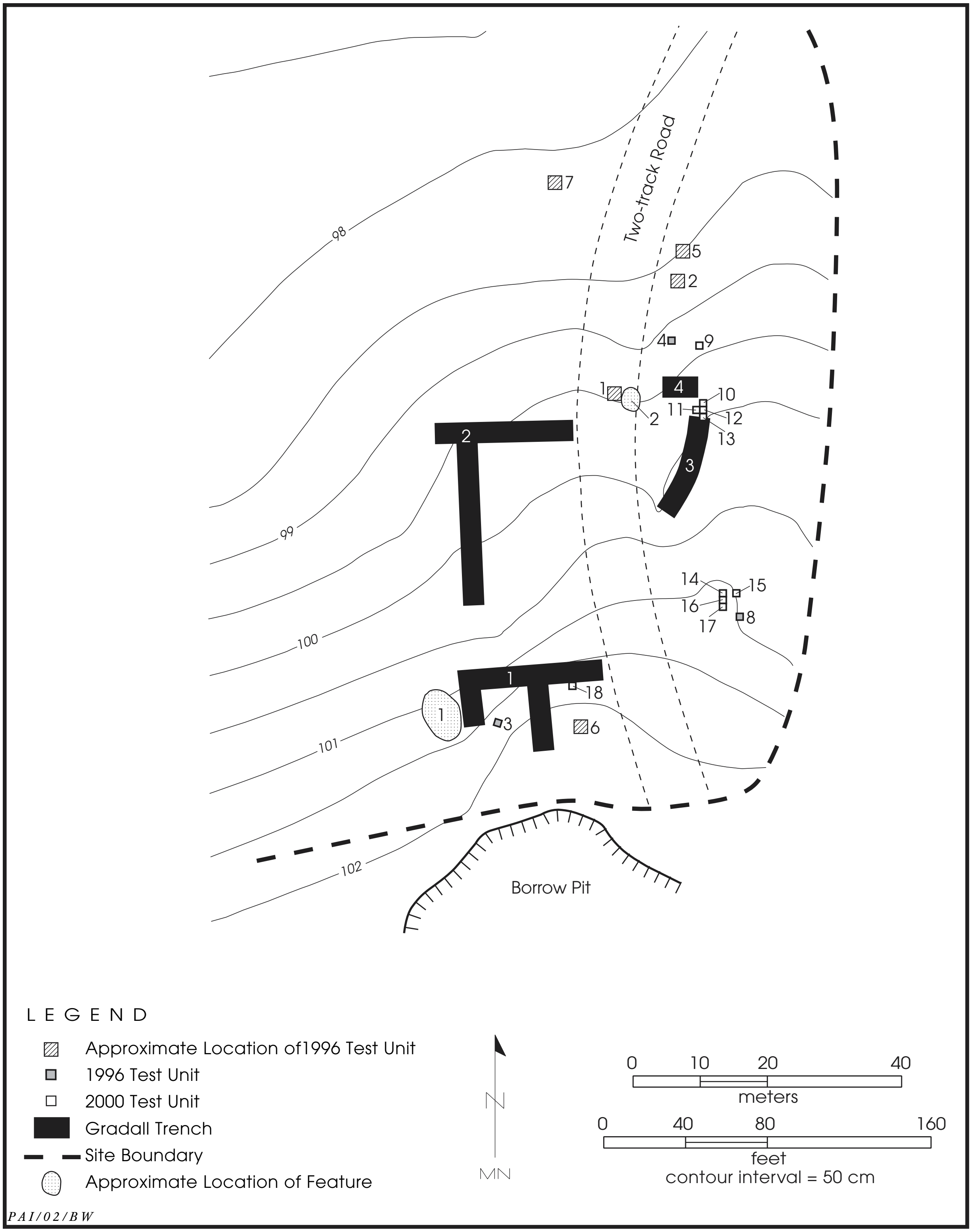


Figure 5.3. Site map of 41CV988.

Table 5.1. Summary of all hand-excavated units, 41CV988

Grid Coordinates	Test Unit	Depth Below Surface (cm)	Starting Elevation (m)	Ending Elevation (m)	Excavated Volume (m^3)
N1022 E1024	9	0–48	99.48	99.00	0.45
N1013 E1025	10	0–47	100.07	99.60	0.45
N1012 E1024	11	0–39	99.99	99.60	0.35
N1012 E1025	12	0–58	100.18	99.60	0.60
N1011 E1025	13	0–59	100.19	99.60	0.60
N985 E1028	14	0–100	101.30	100.30	1.00
N985 E1030	15	0–100	101.06	100.06	1.00
N984 E1028	16	0–101	101.41	100.40	1.00
N983 E1028	17	0–109	101.59	100.50	1.10
N973 E1005	18	0–91	101.81	100.90	0.90
Total					7.45

Note: All test units measure 1x1 m.

(excavated in 1996), Test Units 14–17 were located on a narrow, intact strip of sediment wedged between two tank trails. Burned rocks and debitage were exposed in this area. Test Unit 18 was situated along the south wall of Gradall Trench 1. The sediments in Test Units 14–18 averaged 93 cm thick.

SEDIMENTS AND STRATIGRAPHY

Cultural materials and features at 41CV988 are encapsulated in a thin late Holocene mantle of sandy sediments (Kibler's [1999] Stratum I, see Chapter 2) derived from the Paluxy Formation, which crops out along the upper slopes of the site. This mantle varies in thickness and pedogenic expression across the site. On the lower slopes of the site, the late Holocene mantle rests on a late Pleistocene to early Holocene deposit showing a truncated soil (Kibler's Stratum II, see Chapter 2). As with many Paluxy sites, the ancient soil has been removed from the upper slopes, and the late Holocene sandy mantle rests directly on weathered Paluxy Formation sandstone.

The profile of Gradall Trench 1 consists of a 91-cm-thick mantle of late Holocene colluvial and slopewash sediments overlying pedogenically altered Paluxy Formation deposits. The late Holocene mantle is imprinted with an A-Bk soil profile. The A horizon (0–32 cm) is a brown very fine sandy loam, and the Bk horizon (32–91 cm) is a yellowish brown silt loam. The underlying Paluxy Formation sediments display a 2Btk-2Btk2 soil profile. The 2Btk horizon (91–103 cm) is a yellowish brown very fine sandy clay loam with many fine $CaCO_3$ filaments and common natural sandstone fragments. The 2Btk2 horizon (103–113+ cm) is a yellowish brown very fine sandy clay loam with common fine $CaCO_3$ filaments and common natural sandstone fragments.

Downslope from Gradall Trench 1, the profile of Test Unit 13 consists of late Holocene colluvial and slopewash deposits overlying late Pleistocene to early Holocene colluvial and slopewash deposits. The late Holocene sediments are imprinted with an A horizon (0–24 cm), which consists of a very dark grayish brown very fine sandy loam. The 2Bt horizon (24–45+ cm) is a yellowish red fine sandy clay.

CULTURAL FEATURES

First exposed in Gradall Trench 3, Feature 5 was present in Test Units 11, 12, and 13 from 99.86 to 99.70 m, or approximately 32 to 48 cm below surface (Figure 5.4). It was a concentration of burned rocks that is interpreted as a deflated hearth. The feature had maximum dimensions of 120 cm east-west by 106 cm north-south and was contained within these three units. The ovate, single layer of burned rocks (n = 122, 33.5 kg) was composed primarily of angular, rounded, and fractured tabular pieces of fossiliferous limestone less than 15 cm in size. Most of the rocks lay flat, and those on angle sloped in various directions. The feature rested on the contact with the underlying rubified soil, and it had been minimally disturbed by roots and the trench excavation. The feature fill

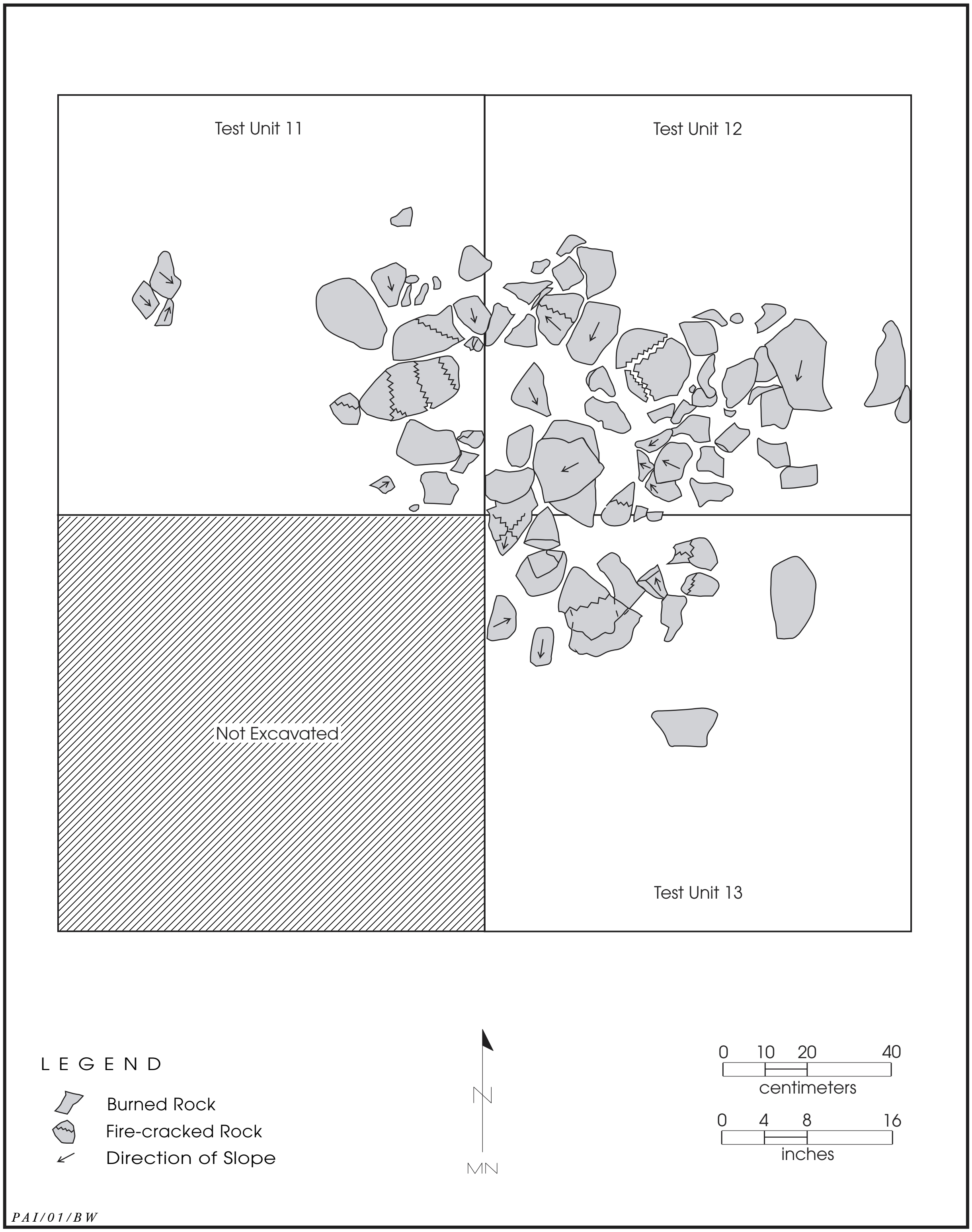


Figure 5.4. Plan view of Feature 5, 41CV988. Feature extends from 99.86 to 99.70 m in Test Units 11, 12, and 13.

produced 10 flakes, and only 1 flotation sample (of 3 processed samples) yielded charred oak wood.

CULTURAL MATERIALS

Most levels excavated from the 10 test units produced stone tools, debitage, or burned rocks, except for Test Unit 18, which yielded only one core (Table 5.2). In addition, Test Units 9, 17, and 18 contained modern intrusive items in the upper 40 cm of sediments. Most of the cultural materials found in Test Units 12 and 13 were associated with Feature 5, the deflated hearth (described above). The four excavations (Test Units 14–17) grouped in the vicinity of Feature 4 generated almost half of the stone artifacts and about 79 percent of the burned rocks. The burned rocks in these units were scattered in various levels, and one flotation sample collected from a general level context contained oak wood. Disturbances to the deposits included root intrusion and bioturbation (primarily from ants).

The artifact assemblage is comprised of 156 chipped stone specimens that consist of 13 tools (8.3 percent), 2 cores (1.3 percent), and 141 pieces of unmodified debitage (90.4 percent). All chipped stone artifacts are manufactured of fine-grained chert, but only 54 specimens (34.6 percent) are identified to named chert types in the Fort Hood taxonomy, and the rest are unidentifiable. The excavations produced a total of 169.95 kg of burned rocks, as well as one unmodified, heavily weathered *Quadrula* sp. mussel shell.

Dart Points

Four of the six dart points are typed as Castroville, Darl, Marcos, and Pedernales (Figure 5.5, Table 5.3). The Darl point shows short step fractures perpendicular to the lateral snap, suggesting post-break use while the specimen was still hafted. Only the Marcos point is manufactured from an identifiable chert type—Anderson Mountain Gray.

Other Chipped Stone Tools

Seven chipped stone tools are produced of indeterminate cherts, and none showed heat treatment. Three late-stage to finished biface specimens are a proximal, an edge, and a distal fragment. Each specimen is indistinct and fairly small, ranging from 19.36 to 25.44 mm in length.

A single multifunctional tool consists of a bifacially modified projection and a slightly concave scraper on one lateral edge (Figure 5.6). The projection exhibits macroscopic wear patterns (i.e., small unifacial step fractures on opposite faces of the lateral edges) consistent with use as a rotary tool (Odell 1981). The specimen is complete and has abraded cortex.

Three complete edge-modified flakes retain varying amounts of cortex. One specimen shows contiguous feather-terminating microfractures along one lateral edge, and another has a 7-mm-deep notch on one lateral edge resembling “practice” pieces described in Turner and Hester (1993:265). The latter may be a discarded flake on which a knapper was practicing deep-notching skills. The third specimen displays unifacial modification of the ventral surface of one lateral edge.

Cores

Two complete specimens are small, multidirectional cores of indeterminate cherts. Hertzian cones (Whittaker 1994:12–13) left from unsuccessful flake detachment on both artifacts suggest the cores were at or near exhaustion when they were discarded.

Unmodified Debitage

Of the 141 unmodified flakes, 52 complete specimens (36.9 percent) were recovered along with 33 proximal fragments (23.4 percent), 54 chips (38.3 percent), and 2 chunks (1.4 percent). Thirty-one flakes retain cortex (22 percent), and the remaining 110 flakes are noncortical debitage (78 percent) (Table 5.4).

Fifty-three pieces of debitage (37.6 percent) correspond to 8 identified chert types. Thirty-six flakes of Anderson Mountain Gray were recovered from above and around Feature 5, and they are sufficiently consistent in color and texture to suspect they may have been removed from the same blank(s). It appears that these flakes were removed from an early- to middle-stage biface. Several of these Anderson Mountain Gray flakes also exhibit attributes of staged heat treatment.

Although these 36 flakes may represent a discrete knapping (or dumping) episode, they are

Table 5.2. Summary of cultural materials, 41CV988

		Artifacts								Faunal Remains	Burned Rocks	
Provenience	Elevation (m)	Dart points	Unidentifiable projectile point	Late-stage to finished bifaces	Multi-functional tool	Edge-modified flakes	Cores	Unmodified debitage	Artifact total	Unmodifed mussel shell	Count	Weight (kg)
Feature 5	99.86–99.70	–	–	–	–	–	–	10	10	–	127	34.00
Test Unit 9	99.48–99.00	–	–	1	1	–	–	14	16	–	–	–
Test Unit 10	100.07–99.60	–	–	–	–	–	–	7	7	–	4	0.50
Test Unit 11	99.99–99.60	–	–	–	–	–	–	6	6	–	2	0.25
Test Unit 12	100.18–99.60	–	–	–	–	–	–	20	20	–	56	4.70
Test Unit 13	100.19–99.60	1	1	–	–	–	–	18	20	–	12	4.20
Test Unit 14	101.30–100.30	–	–	1	–	2	1	26	30	–	110	14.50
Test Unit 15	101.06–100.06	1	–	–	–	–	–	14	15	–	182	14.50
Test Unit 16	101.41–100.40	1	–	1	–	1	–	21	24	–	262	52.50
Test Unit 17	101.59–100.50	–	–	–	–	–	–	5	5	1	210	44.80
Test Unit 18	101.81–100.90	–	–	–	–	–	1	–	1	–	–	–
Subtotal		3	1	3	1	3	2	141	154	1	965	169.95
Surface		2	–	–	–	–	–	–	2	–	–	–
Total		5	1	3	1	3	2	141	156	1	965	169.95

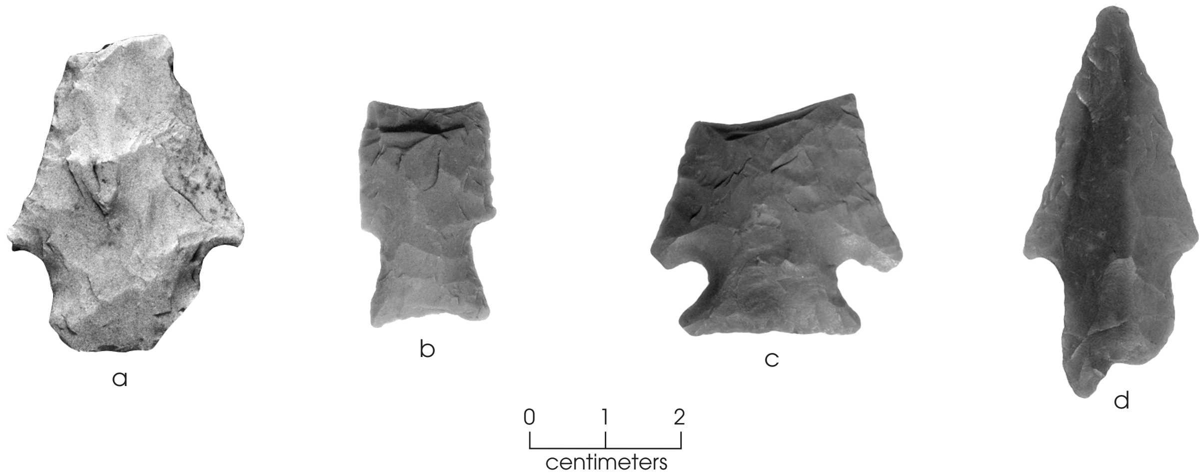


Figure 5.5. Dart points, 41CV988.

not necessarily associated with Feature 5, either functionally or chronologically.

CHERT SOURCING AT 41CV988

When the 543 chipped stone artifacts recovered from previous investigations (Kleinbach 1999:Table 12) are added to the 156 specimens recovered during this phase of testing (see Table 5.2), the resulting sample is 699 chipped stone artifacts. The identifiable cherts within these assemblages then provide a clearer picture of the use of lithic raw materials at 41CV988. As shown in Table 5.5, 54 percent of the total chipped stone artifacts were assigned to 14 chert types in the Fort Hood chert taxonomy, and these types are grouped into local, nearby, and long-distance sources according to their distance from the site. When the chipped stone artifacts are viewed in this way, the data show that 47 percent of the materials were probably being obtained locally, and some 32 percent of the materials were probably brought in from more than 15 km.

SUMMARY AND INTERPRETATIONS

Since 41CV988 was first recorded in 1986, cedar clearing, tank traffic, and erosion have been the primary disturbances observed by various investigators. Despite the damage that had occurred, site investigations in 1996 identified shallowly buried intact features with associated artifact assemblages, and discovery of charred corm (plant root) fragments was particularly significant because this was considered a rare occurrence in archeological contexts. In 1996, there was a 20-to-30-cm thick cultural zone present to a maximum depth of 43 cm over the eastern portion of the site. In 1998, however, 41CV988 was damaged by mechanical tree clearing and intensive tank maneuvers.

A 1999 site assessment noted tree clearing and tank maneuvers as the major factors disturbing at least the upper 15 cm of matrix, with tree upheaval affecting up to 30 cm of sediment in many areas. As of 1999, it appeared that the cultural deposits over most of the site had been disturbed to the point that they lacked contextual integrity (Kleinbach 1999:12). Nevertheless, 41CV988 was chosen for further testing to determine if interpretable subsurface cultural deposits remained, particularly in areas where sediments were the thickest.

Test units in the eastern portion of the site contained sparse cultural materials, but modern items were present to 40 cm below the surface. The Gradall trenches in the vicinity of these units also were virtually devoid of cultural materials. Spaced approximately 30 m apart, two groups of excavations concentrated on a narrow strip of intact sediment wedged between two heavily used tank trails were the most productive. Four contiguous units were placed around Feature 5, a 16-cm-thick deflated hearth yielding a minute piece of charred wood. Interestingly, debitage associated with the hearth is of a single chert type and may represent a single, early-stage lithic reduction episode. Four other test units were clustered just upslope from Feature 5 and close to a previously excavated

Table 5.3. Projectile point provenience and attributes, 41CV988

Nonmetric Attributes						Metric Attributes (mm)						
Point Type	Provenience*	Completeness	Chert Type	Patination	Heating	Maximum length	Blade length	Blade width	Haft length	Neck width	Base width	Maximum thickness
Unidentified projectile point	TU 13, 99.80–99.70	distal fragment	indeterminate dark gray	none	none	13.62	–	–	–	–	–	3.94
Castroville	surface	proximal fragment	indeterminate white	none	none	42.06	–	31.61	14.03	20.69	20.73	6.84
Darl	TU 13, 100.00–99.90	proximal fragment	indeterminate light brown	none	none	30.10	–	18.25	13.19	12.29	16.11	7.07
Marcos	surface	proximal fragment	Anderson Mountain Gray	none	low	32.26	–	33.79	11.11	17.46	24.63	7.10
Pedernales	TU 16, 100.49	nearly complete	indeterminate mottled	none	none	51.91	32.33	23.59	19.36	14.75	15.28	7.88
Untypeable dart point	TU 15, 101.06–100.96	proximal fragment	indeterminate light brown	none	none	17.20	–	–	12.84	–	–	5.84

* Measurements are in meters.

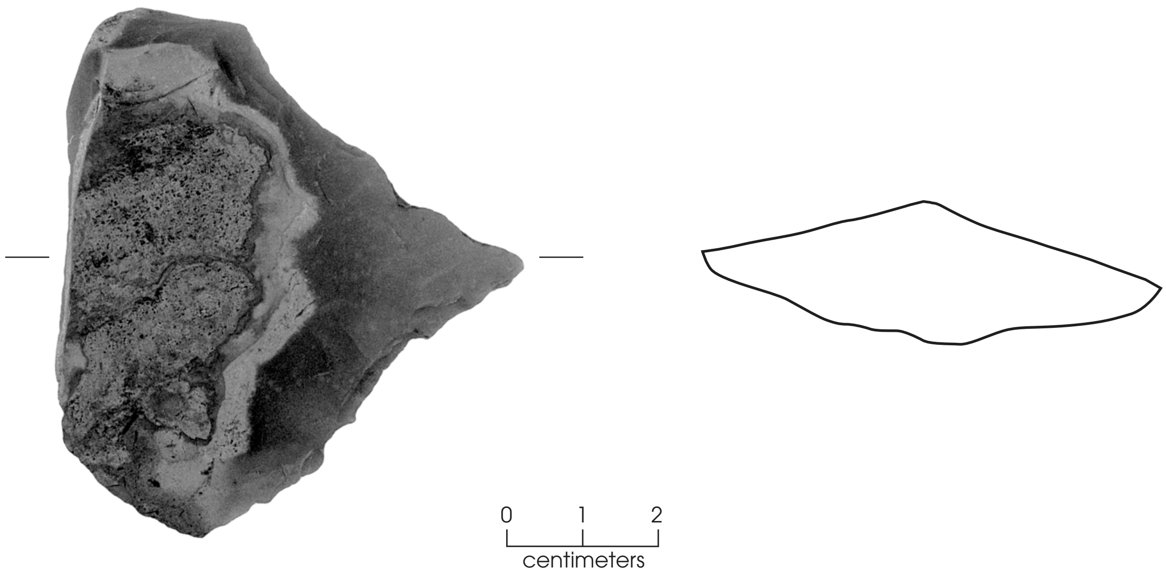


Figure 5.6. Multifunctional tool, 41CV988.

hearth. Here, the 85-to-100-cm thick sediments produced almost half of the site's total artifacts, as well as 75 percent of all burned rocks (by weight). These materials generally occurred throughout the deposits, but all of the deposits are disturbed and no discrete cultural lenses or features were apparent.

In conclusion, the cultural features and artifacts at 41CV988 are all encapsulated within the late Holocene sandy mantle derived from weathering of Paluxy sandstone and slopewash. Because of extensive disturbance by heavy machinery, there is no hope of finding intact features or defining meaningful cultural assemblages. The current testing results support the 1999 site evaluation by Kleinbach (1999:12). Both investigations indicate that the site has been seriously damaged and contains no significant intact cultural deposits. Site 41CV988 is recommended as not eligible for listing in the National Register of Historic Places (see Chapter 9).

Table 5.4. Summary of unmodified debitage by chert type and cortex percentage, 41CV988

	Cortex				
Chert Type	0%	1–50%	50–99%	100%	Total
Anderson Mountain Gray	34	2	–	–	36
Cowhouse Two Tone	–	1	–	–	1
Cowhouse White	2	–	–	–	2
Fort Hood Gray	1	–	–	–	1
Fort Hood Yellow	7	–	–	–	7
Heiner Lake Blue	2	–	–	–	2
Heiner Lake Tan	1	–	–	–	1
Heiner Lake Translucent Brown	2	1	–	–	3
Subtotal	49	4	–	–	53
Indeterminate chert types	61	24	2	1	88
Total	110	28	2	1	141

Table 5.5. Chert sources represented in the chipped stone artifacts, 41CV988; sample includes 543 specimens reported in Kleinbach (1999:Table 12) and 156 specimens in this report

Source Group	Proximity to 41CV988	Points	Other chipped stone tools	Cores	Unmodified flakes	Total	Percent of all identifiable sources
Local Sources	less than 5 km	2	0	0	177	179	47.35
Nearby Sources	5 to 15 km	1	0	0	76	77	20.37
Long-distance Sources	more than 15 km	5	1	0	116	122	32.28
Subtotal of Identified Cherts		8	1	0	369	378	100.00
All Indeterminate Chert Types		5	13	2	301	321	
Total Chipped Stone Artifacts		13	14	2	670	699	

Chert types represented in the 41CV988 assemblage are assigned to the following source groups based on Abbott and Trierweiler (1995:Appendix I) and D. Boyd (1999):

Local Sources	**Nearby Sources**	**Long-distance Sources**
Anderson Mountain Gray	Heiner Lake Translucent Brown	East Range Flecked
Cowhouse Two Tone		Fort Hood Gray
Cowhouse White		Fort Hood Yellow
Fossiliferous Pale Brown		Gray-Brown-Green
Heiner Lake Blue		Owl Creek Black
Heiner Lake Tan		
Seven Mile Mountain Novaculite		
Table Rock Flat		

INVESTIGATIONS AT 41CV1141

Gemma Mehalchick, Christopher W. Ringstaff, and Karl W. Kibler

6

PREVIOUS INVESTIGATIONS

Survey and Monitoring

Masson and Michaels (Texas A&M University) first recorded the site on 21 March 1985. Burned rock concentrations and scatters, as well as bifaces and flakes, were observed, and two untyped dart points were collected. Maximum site dimensions were 250x175 m. Tracked vehicles and erosion disturbed about half of the site, but the rest of the area supported dense vegetation and appeared undisturbed.

On 20 January 1988, Dureka, Petersen, and Kirkland (Texas A&M University) monitored the site, and its dimensions were enlarged to 275x200 m, based on the extent of cultural materials. Burned rocks and lithic artifacts were again noted, as were hematite and limonite cobbles. The site was interpreted as a paint stone processing area, and it was recommended the site be kept off limits to tracked vehicles.

Reconnaissance Survey and National Register Testing

On 23 September 1992, Abbott and Kleinbach (Mariah Associates) visited and evaluated the site. The site size was modified to 240x175 m based on observed cultural materials and features (Figure 6.1). The site was situated on a gently sloping Killeen surface developed on an outcrop of the Paluxy sand. A 20-cm-thick mantle of loamy, fine sands was deposited on an ancient soil by colluvial or slopewash processes. This soil consisted of a truncated, strongly developed sandy soil consisting of a highly rubified B21t-B22w-Cox sequence. Most of the burned rocks and debitage were observed in the slopewash deposits along the two-track roads. One Ellis and one Pedernales dart point were collected from the surface. Three burned rock features also were identified within a 40x40-m area in the western portion of the site. Tank tracks heavily damaged Feature 1, a 5x5-m midden with associated charcoal-stained soil and debitage. Feature 2, a basin shaped-hearth containing charcoal and oxidized soil, was exposed at 17–26 cm in a road cut. Feature 3 consisted of a deflated burned rock concentration visible on the surface. Vehicular traffic and subsequent erosion of the roads into gullies up to 1 m deep severely disturbed the western third of the site. The rest of the site showed little evidence of disturbance by sheet erosion. Because the site possibly contained intact cultural deposits, shovel testing was warranted.

On 7 October 1992, a Mariah Associates crew excavated one 1x1-m test pit and 30 shovel tests. Test Pit 1 was placed over the intact portion of Feature 2, and the basin-shaped hearth was encountered at 17–26 cm. The hearth had maximum excavated dimensions of 61 cm north-south by 55 cm east-west, but the road cut had destroyed the western edge of the feature. Feature 2 consisted of 16 burned rocks (3 kg), and a biface, debitage, and flotation and charcoal samples were recovered from the fill. From the surface to 27 cm, the sediment above and around the feature produced burned rocks, flakes, a core, and charcoal. Thirty shovel tests were excavated to 34 cm or less, and 14 tests were devoid of cultural materials. The 16 positive tests contained two untyped dart points, debitage and burned rocks, primarily in the upper 20 cm of deposits. Shovel Tests 6 and 10, in the vicinity of Feature 2, also encountered dense quantities of burned

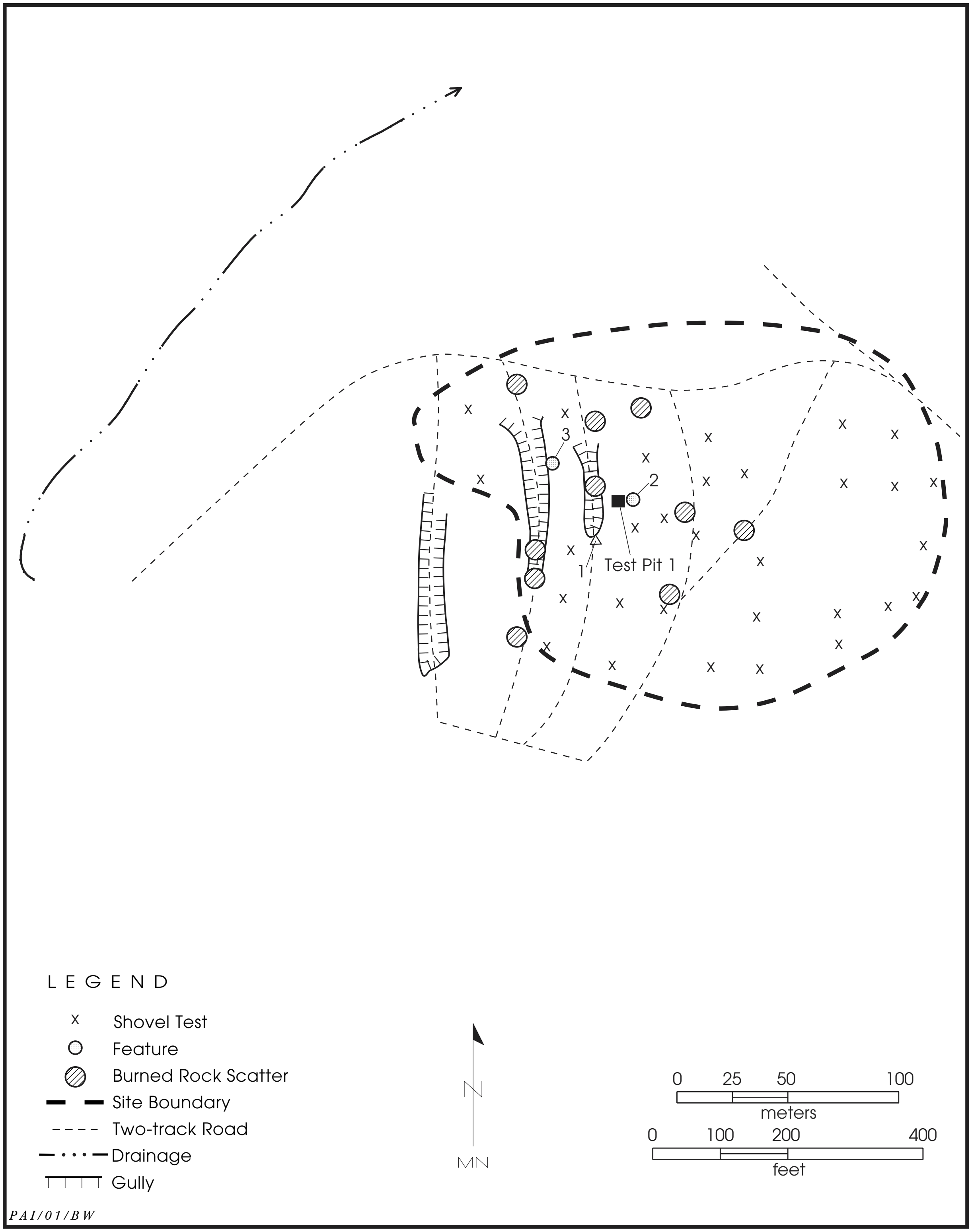


Figure 6.1. Mariah Associates site map of 41CV1141 (modified from Trierweiler, ed. 1994:A1281).

rocks probably representing buried features. The shovel testing results clearly indicated the presence of intact archeological deposits, and 41CV1141 was recommended as eligible for listing in the National Register (Trierweiler, ed. 1994:A1280–A1284).

Damage Assessment and Site Evaluation

From August 1998 through March 1999, staff at the Fort Hood Cultural Resource Management Office revisited 165 archeological sites to identify those damaged by tree clearing, then assess and quantify that damage (Kleinbach 1999). At 41CV1141, damage from tree clearing was confined to the western site margin, affecting just more than 10 percent of the entire surface. The upper 20 cm of deposits were disturbed throughout this area, and the maximum depth of disturbance was 50 cm where trees had been uprooted. The previously excavated test pit was located again, and the clearing activity did not affect the intact cultural component and features noted in 1992. Investigations mentioned that "the context of shallowly buried cultural deposits west of Feature 2 and along the west edge of the site has been compromised…" and recommended that "data recovery should be implemented on a number of Paluxy sites. Because most of this site remains intact, it should be considered as a candidate for mitigation (Kleinbach 1999:22)."

WORK ACCOMPLISHED

PAI investigations were conducted at 41CV1141 August 8–15, 2000 (Figure 6.2). Before excavations began, the site area was surveyed, and Test Pit 1 and Features 1 and 3 were re-located. Burned rocks and sparse debitage were observed in all road cuts, and two Ensor dart points were surface collected.

Mechanical excavations consisted of 13 backhoe trenches excavated across the central portion of the site, and locations were based on past investigations and current observations. Each trench was 0.7 m wide, but they ranged from 6 to 22.5 m long and 0.25 to 0.90 m deep (Table 6.1). Nine trenches were devoid of cultural materials, and one trench exposed only sparse, scattered burned rocks. Burned rock features were exposed in three trenches—Backhoe Trenches 4, 6, and 11. Backhoe Trench 6 was excavated near the road cut where Feature 1 was exposed, and the burned rock midden was visible in both trench walls at 0–60 cm. Backhoe Trenches 4 and 11 were situated east of Backhoe Trench 6 approximately 13 m apart on opposite sides of a road where dense burned rocks were observed. Two separate, amorphous stains (one was later designated Feature 5) and a 30-cm-thick burned rock midden (Feature 7) were exposed in Backhoe Trench 4, and a 40-cm-thick burned rock midden (Feature 4) was encountered in Backhoe Trench 11.

Hand excavations consisted of twelve

Table 6.1. Summary of backhoe trenches, 41CV1141

Backhoe Trench	Dimensions (m)	Results
1	6.0x0.7x0.35	–
2	12.0x0.7x0.35	occasional burned rock at 15 cm
3	9.5x0.7x0.40	–
4	22.5x0.7x0.50	Feature 7 (burned rock midden) at 10–40 cm at north end of trench; Feature 5 (organic stained pit) at 10 cm and one amorphous stain at 25 cm near south end of trench
5	9.0x0.7x0.40	–
6	12.5x0.7x0.90	Feature 1 (burned rock midden) exposed in both walls at 0–60 cm at north end
7	8.0x0.7x0.35	–
8	12.0x0.7x0.32	–
9	15.0x0.7x0.25	–
10	17.0x0.7x0.25	–
11	15.0x0.7x0.70	Feature 4 (burned rock midden) exposed in both walls at 0–60 cm; visible the entire length of the trench
12	10.0x0.7x0.25	–
13	8.0x0.7x0.25	–

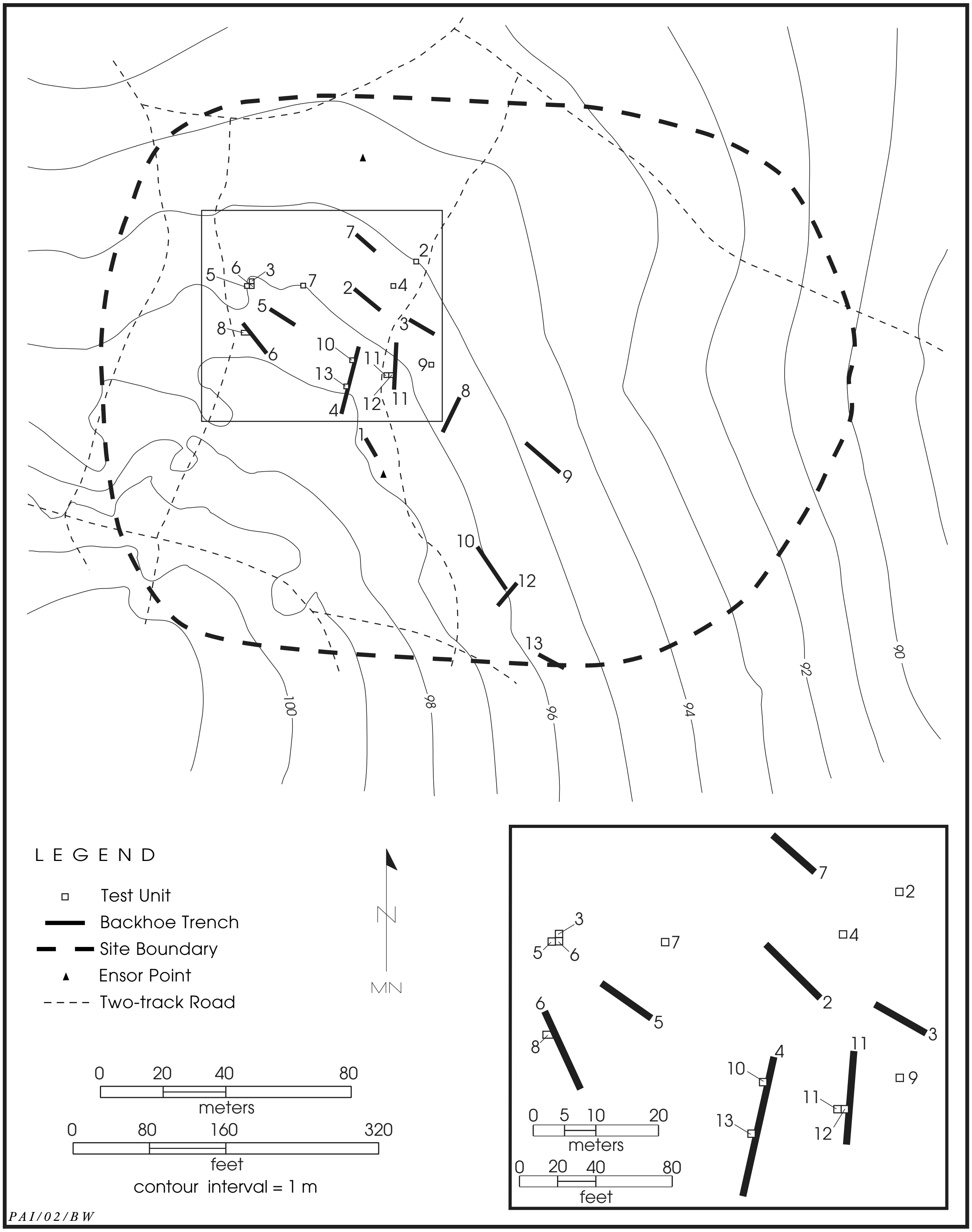


Figure 6.2. Site map of 41CV1141.

1x1-m test units (Test Units 2–13), with a total volume of 5.75 m^3 manually excavated (Table 6.2). Test units were placed in and around exposed features and scatters of cultural materials. The amount of sediment excavated from test units varied between 25 and 70 cm. Each excavation terminated at the contact with the dense, argillic clay (B) horizon. Near the north central portion of the site, Test Unit 2 was placed along a road cut exposing burned rocks, and Test Unit 4 was located southwest of Test Unit 2. Five test units (Test Units 3 and 5–8) were situated in a 30x25-m area encompassing Features 1 and 2. Test Units 9–12 were excavated along and in the proximity of Backhoe Trenches 4 and 11, where burned rock middens and soil stains were encountered.

SEDIMENTS AND STRATIGRAPHY

The cultural materials and features at 41CV1141 are encapsulated in a late Holocene mantle of sandy sediments (Kibler's [1999] Stratum I) derived from the Paluxy Formation outcrop. As at many Paluxy sites, this sandy mantle varies in thickness and pedogenic expression across the site. At 41CV1141, parts of this mantle also contain a substantial anthropogenic component. The late Holocene deposit rests on an eroded late Pleistocene to early Holocene deposit of colluvial and slopewash sediments (Kibler's [1999] Stratum II) that are highly modified.

Within Backhoe Trench 6, the late Holocene mantle displays an A-Bw soil profile, but the underlying earlier deposit is imprinted with a 2Bt horizon. The A horizon (0–32 cm) is a very dark gray very fine sandy loam. Burned and fractured limestone rocks and other cultural debris are common throughout the soil horizon. The Bw horizon (32–58 cm) is a dark brown sandy clay loam. The 2Bt horizon (58–72+ cm) represents a truncated dark reddish brown silty clay soil.

In Backhoe Trench 11, the late Holocene deposit displays an A horizon, but the underlying earlier deposit is imprinted with a 2Bt horizon. The soil horizons vary in depth within the trench. The A horizon (0–26 cm and 0–59 cm) is very dark brown very fine sandy loam. There are many burned and fractured rocks throughout the horizon. The 2Bt horizon (26–38+ cm and 59–68+ cm) is a dark brown sandy clay loam. The varying depths below the surface of the top of the 2Bt horizon show that the soil was severely eroded and riddled with gullies before the sandy material that comprises the late Holocene mantle accumulated.

CULTURAL FEATURES

Parts or all of six features—three burned rock middens (Features 1, 4, and 7), an organic stain (Feature 5), one hearth (Feature 6), and one occupation zone (Feature 8)—were excavated (Table 6.3). The excavated features are described below, but two previously reported features (Features 2 and 3) were not investigated.

The first burned rock midden (Feature 1) was present in Test Unit 8 from 17 to 77 cm. The upper 50 cm of the deposit extended across

Table 6.2. Summary of all hand-excavated units, 41CV1141

Grid Coordinates	Test Unit*	Depth Below Surface (cm)	Starting Elevation (m)	Ending Elevation (m)	Excavated Volume (m^3)
N1084 E1091	2	0–48	95.08	94.60	0.50
N1077 E1036	3	0–40	96.20	95.80	0.40
N1077 E1082	4	0–24	95.39	95.15	0.25
N1076 E1035	5	0–42	96.22	95.80	0.40
N1076 E1036	6	0–44	96.24	95.80	0.45
N1076 E1053	7	0–36	96.06	95.70	0.35
N1061 E1034	8	0–87	96.87	96.00	0.85
N1054 E1091	9	0–45	95.25	94.80	0.45
N1053 E1069	10	0–58	96.38	95.80	0.45
N1049 E1081	11	0–69	96.19	95.50	0.70
N1049 E1082	12	0–70	96.10	95.40	0.50
N1045 E1067	13	0–44	96.74	96.30	0.45
Total					5.75

* All test units measure 1x1 m except Test Units 10 and 12, which measured 1.0x0.7 m.

Table 6.3. Summary of features, 41CV1141, by provenience

Feature No.	Feature Type	Provenience**	Elevation (m)	Depth Below Surface (cm)	Size (estimated)
1	Burned rock midden	Surface, BHT 6, TU 8	96.70–96.10	17–77	(5x5 m, minimum)
2*	Basin-shaped hearth	Test Pit 1	–	17–26	61x55 cm, minimum
3*	Burned rock concentration	Surface	–	0–?	Unknown
4	Burned rock midden	BHT 11, TU 11, TU 12	96.00–95.50***	19–59	20x10 m
5	Organic-stained pit	BHT 4, TU 13	96.60–96.51	14–23	32x15 cm
6	Ovate hearth	TU 3, TU 6	96.10–95.95	10–25	80x65 cm
7	Burned rock midden	BHT 4, TU 10	96.20–95.90	18–48	(7.5x5 m, minimum)
8	Occupation zone	TU 2	94.90–94.80	18–28	(10x5 m)

*Feature was recorded or investigated in 1996 but not in the 2000–2001 season.

**BHT = backhoe trench; TU = test unit.

***Feature 4 is only 40 cm thick but dips eastward in Test Units 11 and 12.

the entire test unit but was confined to the northern two-thirds of the excavation at 67–77 cm. Overall, the feature sloped gradually from south to north. The midden contained 926 burned pieces of fossiliferous limestone (172 kg), 7 stone tools including a Pedernales dart point, 81 flakes, and 1 spirally fractured mammal long bone fragment (Table 6.4). Most of the burned rocks were less than 15 cm in size and consisted of angular or rounded pieces. A small number of thin, flat slabs were larger and measured 15–25 cm. Charcoal and organic-stained sediment were observed in the fill, but no discrete, internal features were apparent within the general midden matrix. Four of five flotation samples produced only oak wood and acorn fragments. Roots were observed throughout the midden, particularly in the upper part of the deposit. Based on surface exposures and excavation results, Feature 1 measures at least 5x5 m and may be associated with Features 2 and 6 (hearths) found 10–15 m to the north.

The second burned rock midden (Feature 4) was exposed for the entire length (15 m) of Backhoe Trench 11, from surface to a maximum depth of 60 cm. It was sampled in Test Units 11 and 12 and had a maximum thickness of 40 cm at about 19–59 cm in both units. The thickness was fairly consistent, but the feature dipped eastward (parallel with the ground surface slope) from a high elevation of 96 m in Test Unit 11 to a low elevation of 95.50 m in Test Unit 12. The two contiguous units produced a total of 1,907 burned rocks (316.50 kg), 8 stone tools including 1 Montell and an untypeable dart point, and 36 pieces of debitage. Overall, the units contained comparable amounts of burned rocks, but one 10-cm level near the top of the midden in Test Unit 11 yielded more than double the number and weight of burned rocks than any other level. Most of the rocks were blocky, angular and subangular fragments of fossiliferous limestone less than 15 cm in size. There were also some larger tabular pieces and slabs measuring up to 35 cm. Charcoal and roots were noted throughout the deposit. Only one of six flotation samples produced oak wood. Excavation results and the dense burned rocks exposed in the road cut indicate that the midden measures 20 m north-south by 10 m east-west.

The third midden (Feature 7) was encountered from 10 to 40 cm in the north end of Backhoe Trench 4. It was sampled in Test Unit 10 from 18 to 48 cm. The feature fill produced 283 burned rocks (47.75 kg), 2 stone tools, 53 flakes, and 1 unmodified mussel shell. This 30-cm-thick deposit also was the only midden to contain a substantial number of *Rabdotus* snail shells. All of the burned rocks were angular and tabular pieces of fossiliferous limestone measuring less than 15 cm. Roots occurred throughout the deposit, and ant bioturbation was observed in the upper 10 cm of fill. There was scattered charcoal present, and one of two flotation samples yielded indeterminate wood. Feature 7 measured at least 7.5 m north-south by 5 m east-west based on surface and subsurface exposures. Although surface manifestations indicate Features 4 and 7 are about 7.5 m apart, their association is unclear.

Table 6.4. Summary of cultural materials, 41CV1141

		Artifacts											Faunal Remains		Burned Rocks	
Provenience	Elevation (m)	Dart points	Early- to middle-stage bifaces	Late-stage to finished bifaces	Misc. biface	End-side scrapers	Other scraper	Gravers-Burins	Edge-modified flakes	Core	Unmodified debitage	Artifact total	Unmodified bone	Unmodifed mussel shell	Count	Weight (kg)
Feature 1	96.70–96.10	1	–	1	–	–	1	–	4	–	81	88	1	–	926	172.00
Feature 4	96.00–95.50	2	1	2	1	–	–	–	2	–	36	44	–	–	1,907	316.50
Feature 5	96.60–96.51	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–
Feature 6	96.10–95.95	–	–	–	–	–	–	–	–	–	4	4	–	–	26	10.50
Feature 7	96.20–95.90	–	–	–	–	1	–	1	–	–	53	55	–	1	283	47.75
Feature 8	94.90–94.80	–	–	–	–	–	–	–	–	–	10	10	–	–	132	22.00
Subtotal		3	1	3	1	1	1	1	6	–	185	202	1	1	3,274	568.75
Test Unit 2	95.08–94.60	–	1	1	–	–	–	–	1	–	41	44	–	–	78	15.00
Test Unit 3	96.20–95.80	–	–	–	–	–	–	–	–	–	38	38	–	–	26	2.25
Test Unit 4	95.39–95.15	–	–	–	–	–	–	–	–	–	6	6	–	–	–	–
Test Unit 5	96.22–95.80	–	–	–	–	–	–	–	–	–	43	43	–	–	22	3.10
Test Unit 6	96.24–95.80	–	–	–	–	–	–	1	1	–	34	36	–	–	16	1.85
Test Unit 7	96.06–95.70	–	1	–	–	–	–	–	–	–	5	6	–	–	–	–
Test Unit 8	96.87–96.00	–	1	1	–	–	–	–	–	1	35	38	–	–	120	14.00
Test Unit 9	95.25–94.80	–	–	–	–	–	–	–	–	–	12	12	–	–	2	0.25
Test Unit 10	96.38–95.80	–	–	–	–	–	–	–	2	–	56	58	–	–	19	1.75
Test Unit 11	96.19–95.50	–	–	–	–	–	–	–	–	–	6	6	–	–	27	1.35
Test Unit 12	96.10–95.40	–	–	1	–	–	–	–	–	–	24	25	–	–	42	9.50
Test Unit 13	96.74–96.30	–	–	–	–	–	–	–	–	–	5	5	–	–	3	0.10
Subtotal		0	3	3	0	0	0	1	4	1	305	317	0	0	355	49.15
Surface	–	2	–	–	–	–	–	–	–	–	–	2	–	–	–	–
Total		5	4	6	1	1	1	2	10	1	490	521	1	1	3,629	617.90

Feature 5 is an organic stained pit first exposed at about 10 cm below surface in the south end of Backhoe Trench 4, but the trench disturbed only a small portion of the feature. Test Unit 13, which straddled the west edge of Backhoe Trench 4, was excavated to expose this feature. The rest of Feature 5 was contained within Test Unit 13 from 14–23 cm. The main portion of the feature was an ovate pit, 32 cm east-west by 15 cm north-south. An irregular-shaped stain extending 15 cm to the north was determined to be a rodent burrow. The pit contains dark-stained sediment and copious charcoal but no rocks (Figure 6.3). The base of the ovate pit was semi-basin shaped, ranging from 2 to 9 cm thick. Roots and rodents were the only observed disturbances to the feature. There was only one flake in the pit fill, but one flotation sample contained elm, hackberry, oak, rose family, and indeterminate woods, along with oak acorn fragments. The feature may be the remnant of a small cooking pit.

Feature 6 was found at 10–25 cm in Test Units 3 and 6 (Figure 6.4). This small, ovate hearth had maximum dimensions of 80 cm north-south by 65 cm east-west. The feature comprised two layers of angular, tabular, and rounded burned rocks (n = 26, 10.5 kg). Most of the rocks were fossiliferous limestone less than 15 cm in size. Larger tabular pieces measuring 15–25 cm were fractured in place. The hearth was slightly basin shaped, with several rocks sloping toward the center of the feature. The feature fill contained four flakes and sparse charcoal. One flotation sample yielded indeterminate wood. Root disturbance was evident, and the hearth rested on compact, rubified sediment and appeared deflated.

In Test Unit 2, Feature 8 comprised a thin layer of burned rocks at 18–28 cm. The feature covered the entire unit and consisted of 132 pieces of burned fossiliferous limestone (22 kg). Only one tabular rock was greater than 15 cm, with the rest fist-sized and smaller, angular and tabular pieces. Ten flakes were recovered from the feature matrix, which roots minimally disturbed. Although charcoal flecks were observed in the matrix, one flotation sample lacked charred plant remains. Based on the excavation results, the feature is interpreted as an occupation zone. Surface and subsurface exposures suggest that Feature 8 has minimum dimensions of 10 m north-south by 5 m east-west.

CULTURAL MATERIALS

Most levels excavated contained chipped stone artifacts or burned rocks (see Table 6.4). Levels devoid of cultural materials were either the uppermost 10–20 cm of deposits or at the base of the excavation where the argillic horizon was encountered. Test Units 7, 11, and 13 also yielded a few modern or historic items in the upper 20 cm of fill. The three burned rock middens, which ranged from 30 to 60 cm thick, produced 36 percent of the chipped stone assemblage, the only faunal remains, and 95 percent of the burned rocks present in all of the excavations. Overall, the test units containing features also yielded the greatest amount of cultural materials from general level contexts. One flotation sample collected outside Feature 4 (midden) produced no charred macrobotanical remains.

The 521 chipped stone artifacts consist of 30 tools (5.8 percent), 1 core (0.2 percent), and 490 pieces of unmodified debitage (94 percent). Eleven bifaces and 10 edge-modified flakes dominate the tool category. All chipped stone artifacts are produced from fine-grained chert, and 17.5 percent of the assemblage is assigned to Fort Hood chert types.

The test units contained 617.9 kg of burned rocks, with six features accounting for 568.75 kg (92 percent). The only faunal remains, one canid- to deer-sized long bone fragment and one *Potamilus purpuratus* mussel shell, were recovered from feature contexts.

Dart Points

Five dart points are comprised of 2 Ensors, 1 Montell, 1 Pedernales, and 1 untypeable (Figure 6.5, Table 6.5). The Ensor points consist of 1 nearly complete specimen and 1 proximal fragment that has a serrated blade; both show heat treatment. The proximal fragment of a Montell point has a small, shallow basal notch and is manufactured from Heiner Lake Translucent Brown chert. The Pedernales point is nearly complete, and the untypeable dart point consists of an alternately beveled distal fragment.

Bifaces

The biface category consists of various fragments that are dominated by late-stage to fin-

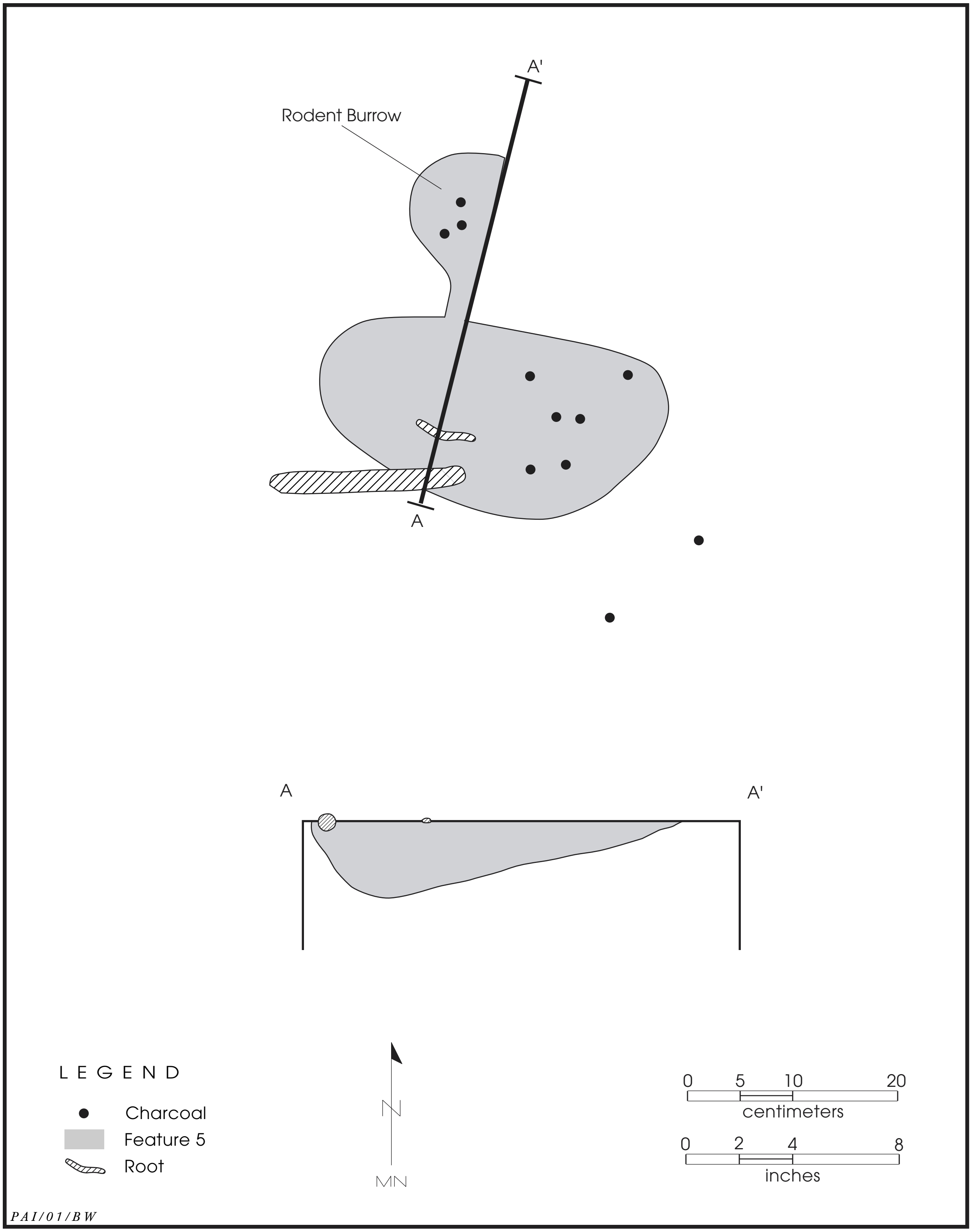


Figure 6.3. Plan and profile of Feature 5 in Test Unit 13, 41CV1141.

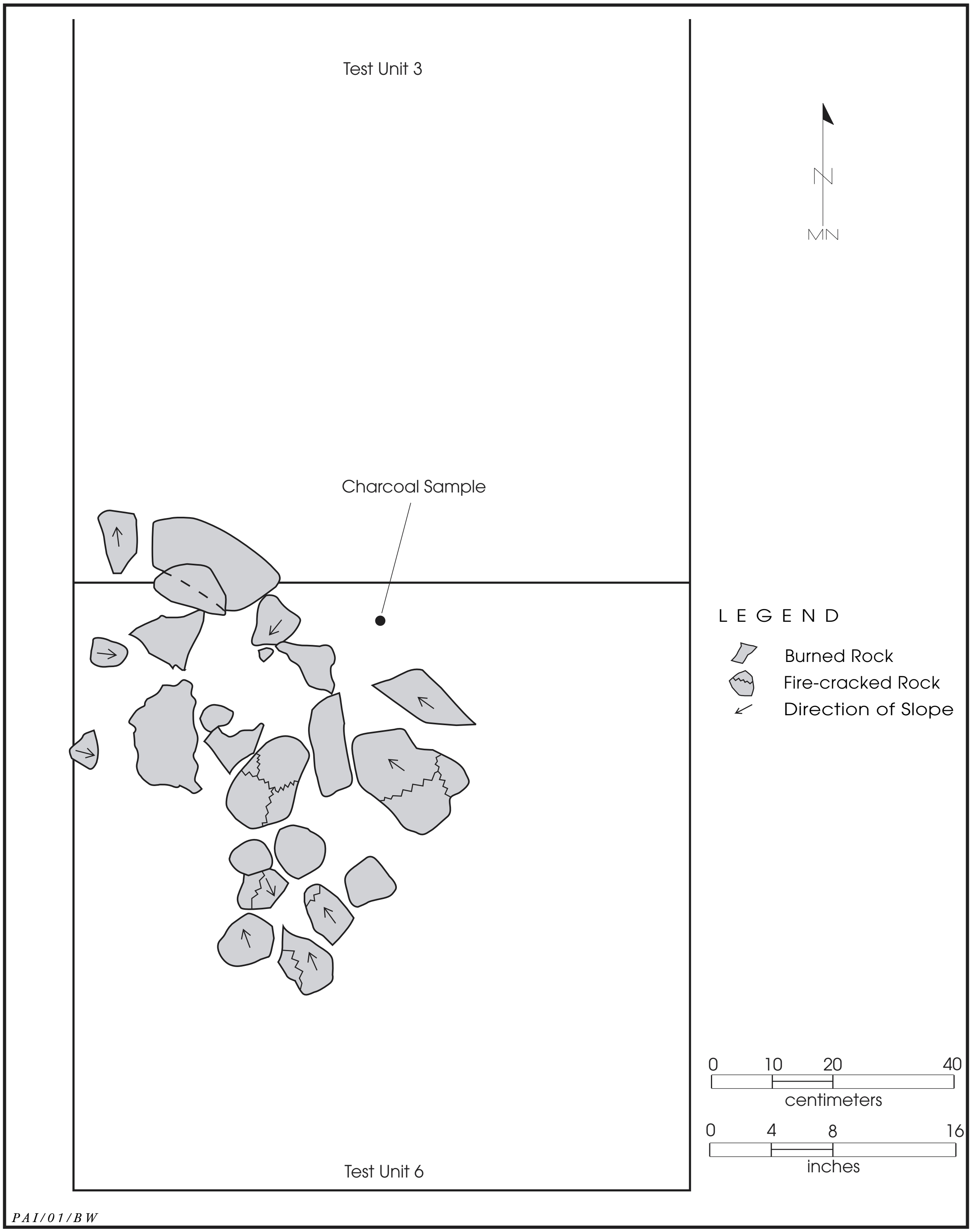


Figure 6.4. Plan of Feature 6, 41CV1141.

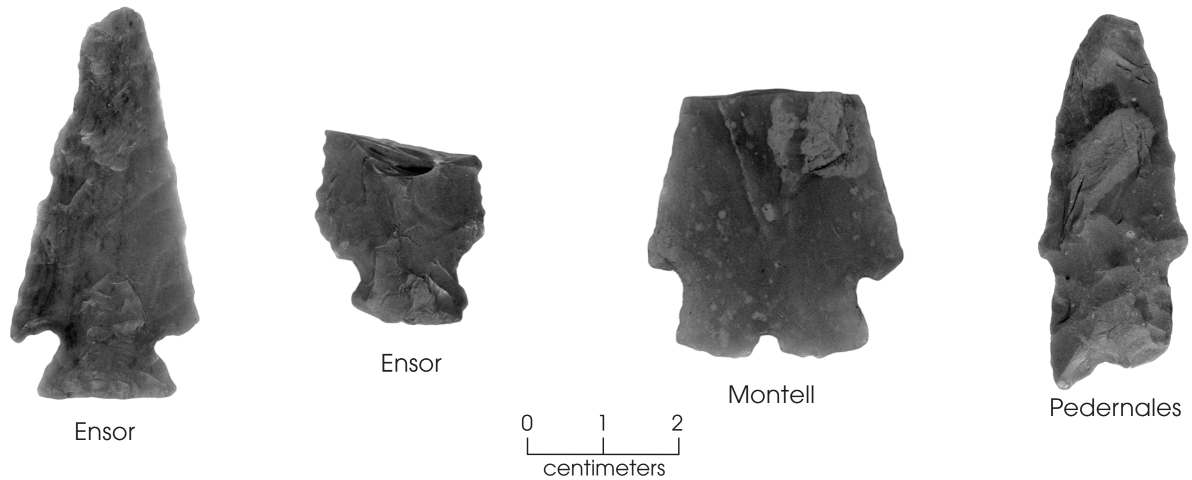


Figure 6.5. Dart points, 41CV1141.

ished specimens (Table 6.6). Two of the 11 bifaces display heat treatment, and 1 has been subjected to high heat shown by the presence of pot lids. Only three late-stage to finished bifaces are assigned to chert types consisting of Anderson Mountain Gray, Cowhouse White, and Owl Creek Black. Lateral edges on two late-stage to finished bifaces may have been used as burins.

Scrapers

One end-side scraper is a distal fragment, and a second specimen, categorized "other," appears complete, although it is made from a flake fragment (Figure 6.6). Both artifacts show macroscopic wear patterns consisting of many small step fractures along the use edges.

Graver-Burin

A single graver is made on the lateral edge of a complete flake manufactured of Fort Hood Yellow chert. The specimen has a small pointed projection created by unifacial pressure retouch. One burin shows multiple pronounced hinge fractures on one lateral edge of a medial flake fragment. The dorsal surface of the specimen retains relatively rough cortex, suggesting the raw material may have originated from an upland primary chert source (as opposed to smooth cortex seen on stream cobbles and lag gravels).

Edge-modified Flakes

Ten edge-modified flakes consist of 5 complete specimens, as well as 1 proximal, 3 medial, and 1 distal fragments. Seven artifacts retain cortex, but none show heat treatment. One specimen is produced from Anderson Mountain Gray chert.

Core

One small, complete, unidirectional core with polished cortex indicates the material was stream rolled and probably obtained from either a gravel lag or bed load environment. Hertzian cones (Whittaker 1994:12–13) left from unsuccessful flake detachment on the platform surface indicates the core was at or near exhaustion when discarded.

Unmodified Debitage

Unmodified debitage accounts for 94 percent (n = 490) of the lithic assemblage. The flake types are classified as 144 complete specimens (29.4 percent), 81 proximal fragments (16.5 percent), 258 chips (52.7 percent), and 7 chunks (1.4 percent). Just more than 80 percent (n = 394) of the debitage lacks cortex, and 19.6 percent (n = 96) of the assemblage are cortical pieces (Table 6.7). Although 17.4 percent of the debitage are assigned to 10 defined Fort Hood chert types, Anderson Mountain Gray constitutes 61.8 percent of the identified cherts. Four groups of debitage, associated with different features, are sufficiently consistent in color and texture to suggest they may have been removed from the same blank or stage biface, although no refits were observed to confirm this. These flakes include 11 resembling Fort Hood

Table 6.5. Dart point provenience and attributes, 41CV1141

Nonmetric Attributes						Metric Attributes (mm)						
Point Type	Provenience*	Completeness	Chert Type	Patination	Heating	Maximum length	Blade length	Blade width	Haft length	Neck width	Base width	Maximum thickness
Ensor	surface	nearly complete	indeterminate mottled	none	low	51.97	43.10	25.43	9.55	12.48	18.87	5.98
Ensor	surface	proximal fragment	indeterminate light brown	none	low	25.84	–	22.90	10.68	12.86	15.74	6.48
Montell	TU 12, 95.80–95.70	proximal fragment	Heiner Lake Translucent Brown	none	none	35.72	–	33.75	10.71	22.76	25.33	6.76
Pedernales	TU 8, 96.40–96.30	nearly complete	indeterminate mottled	none	none	49.60	32.47	19.97	17.95	14.72	16.15	6.84
Untypeable	TU 12, 95.70–95.60	distal fragment	indeterminate light brown	light	none	41.36	–	–	–	–	–	6.81

* Measurements are in meters.

Table 6.6. Biface types by completeness, 41CV1141

Completeness	Early- to middle-stage	Late-stage to finished	Miscellaneous	Total
Proximal fragment	1	–	–	1
Medial fragment	2	2	–	4
Distal fragment	–	1	–	1
Edge fragment	1	2	1	4
Indeterminate	–	1	–	1
Total	4	6	1	11

Yellow from Feature 4, 7 made of heat treated Anderson Mountain Gray from Feature 6, 17 of Anderson Mountain Gray from Feature 8, and 9 heat-treated specimens manufactured of an indeterminate red chert found near Feature 1.

CHERT SOURCING AT 41CV1141

When the 125 chipped stone artifacts recovered from previous testing (Trierweiler ed. 1994:Appendix A, Table 41CV1141.2) are combined with the 521 specimens recovered during this phase of testing, the resulting sample is 646 chipped stone artifacts. The identifiable cherts within these assemblages then provide a clearer picture of the use of lithic raw materials at 41CV1141. As shown in Table 6.8, 16 percent of the total chipped stone artifacts were assigned to 12 chert types in the Fort Hood chert taxonomy, and these types are grouped into local, nearby, and long-distance sources according to their distance from the site. When the chipped stone artifacts are viewed in this way, the data show that 61 percent of the materials were probably being obtained locally, and some 38 percent of the materials were probably brought in from more than 15 km.

SUMMARY AND INTERPRETATIONS

The current investigations at 41CV1141 confirm the 1999 assessment stating that most of the site remains intact (Kleinbach 1999:22). In particular, past and present excavations delineate a 60-m east-west by 40-m north-south area in the north-central portion of the site where prehistoric activities are concentrated. Here, seven features and associated stone artifact assemblages reveal intensive use of the site. Although three burned rock middens are identified, Features 4 and 7 may represent one continuous subsurface deposit, whereas the excavations clearly differentiate Feature 1 as a separate midden.

Although the middens have the potential to contain internal features, none were encountered during this phase of work. Sampling is

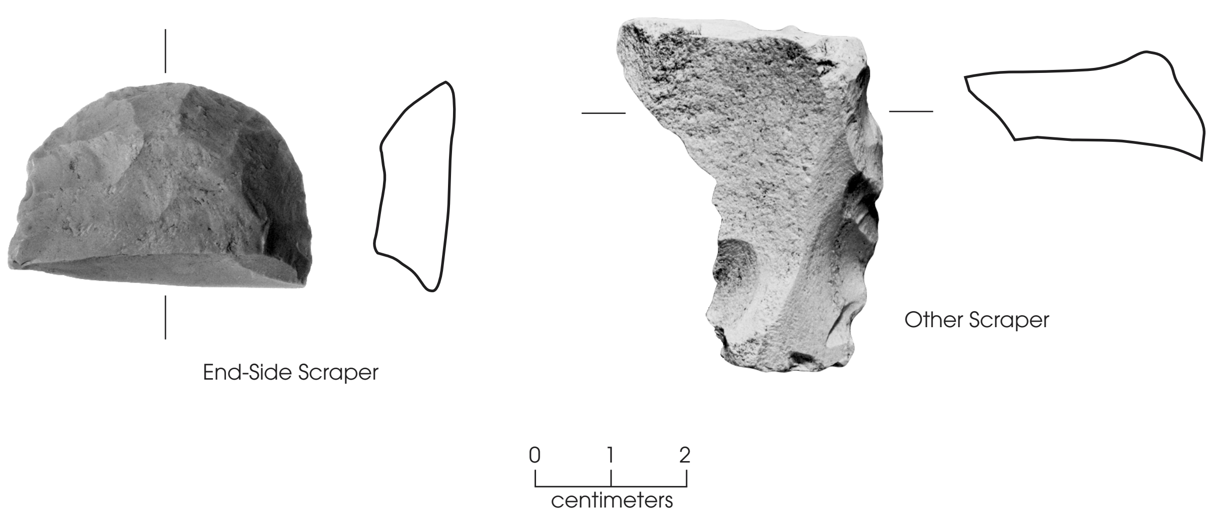


Figure 6.6. Scrapers, 41CV1141.

Table 6.7. Summary of unmodified debitage by chert type and cortex percentage, 41CV1141

Chert Type	Cortex 0%	1–50%	50–99%	100%	Total
Anderson Mountain Gray	49	2	1	–	52
Cowhouse Two Tone	–	4	–	–	4
Cowhouse White	1	–	–	–	1
East Range Flecked	1	–	–	–	1
Fort Hood Gray	1	–	–	–	1
Fort Hood Yellow	7	1	1	–	9
Gray-Brown-Green	7	4	–	–	11
Heiner Lake Blue	1	1	–	–	2
Heiner Lake Tan	1	–	–	–	1
Owl Creek Black	1	1	–	1	3
Subtotal	69	13	2	1	85
Indeterminate chert types	325	58	22	0	405
Total	394	71	24	1	490

limited, and the results are by no means conclusive. Identifiable floral remains from midden contexts are oak wood and acorn fragments, which hint at subsistence resources and processing activities. Downslope and distinct from the middens is Feature 8. This deposit is interpreted as a 10-cm-thick occupation zone, but the quantity of burned rocks suggests that it may be an incipient midden.

Notably, three discrete features occur just beyond the edges of the middens. Feature 2 (a previously excavated hearth), Feature 5 (a rockless pit filled with dark-stained sediment), and Feature 6 (a small oval hearth) appear to reflect activities that occurred close to but just outside the middens. Charred oak acorns were found in Feature 5, and a concentration of flakes near Feature 6 may represent an isolated knapping episode.

Diagnostic artifacts consist of Ensor, Montell, and Pedernales dart points, suggesting Late Archaic occupation(s). This finding is consistent with several dated components at other Paluxy sites, although there is no chronometric data for 41CV1141. All of the cultural remains are buried within the late Holocene slopewash sediments (Kibler's [1999] Stratum I) that are up to 70 cm thick.

The base of each feature rests on or just above the contact with a well-developed, highly rubified clayey soil (the late Pleistocene or early Holocene Stratum II defined by Kibler [1999]), indicating a stable surface. The additional testing results confirm the presence of spatially discrete archeological deposits. It is recommended that 41CV1141 remains eligible for listing in the National Register of Historic Places (see Chapter 9). And the sites meets two of the four eligibility red flag criteria Abbott and Trierweiler (1995a:37) defined. It contains organic remains in primary context and discrete cultural occupations with high chronometric potential.

Table 6.8. Chert sources represented in the chipped stone artifacts, 41CV1141; sample includes 125 specimens reported in Trierweiler, ed. (1994: Appendix A, Table 41CV1141.2) and 521 specimens in this report

Source Group	Proximity to 41CV988	Points	Other chipped stone tools	Cores	Unmodified flakes	Total	Percent of all identifiable sources
Local Sources	less than 5 km	0	3	0	60	63	61.17
Nearby Sources	5 to 15 km	1	0	0	0	1	0.97
Long-distance Sources	more than 15 km	0	2	0	37	39	37.86
Subtotal of Identified Cherts		1	5	0	97	103	100.00
All Indeterminate Chert Types		7	20	1	515	543	
Total Chipped Stone Artifacts		8	25	1	612	646	

Notes: Chert types represented in the 41CV1141 assemblage are assigned to the following source groups based on Abbott and Trierweiler (1995:Appendix I) and D. Boyd (1999):

Local Sources	**Nearby Sources**	**Long-distance Sources**
Anderson Mountain Gray	Heiner Lake Translucent Brown	East Range Flecked
Cowhouse Two Tone		Fort Hood Gray
Cowhouse White		Fort Hood Yellow
Fossiliferous Pale Brown		Gray-Brown-Green
Heiner Lake Blue		Owl Creek Black
Heiner Lake Tan		

INVESTIGATIONS AT 41CV595, THE FIREBREAK SITE

Gemma Mehalchick, Christopher W. Ringstaff, and Karl W. Kibler

7

This first section of this chapter describes the site setting, and the second section summarizes the history of previous archeological investigations and disturbances at 41CV595. These events, which all occurred between 1984 and 1998, were the initial recording of the site, followed by a revisit, monitoring, site reconnaissance, and shovel testing, National Register testing, the firebreak blading incident, and a damage assessment investigation. All other sections in this chapter focus on the archeological investigations Prewitt and Associates, Inc. (PAI), archeologists carried out at 41CV595 in 2000. These sections deal with the work accomplished, sediments and stratigraphy, and archeological findings (cultural features and artifacts). The information in this chapter is largely descriptive, and the detailed analysis and interpretation of the archeological data are found in Chapter 8. In this and all following chapters, the additional testing and subsequent block excavations are considered together for descriptive and analytical purposes, and they constitute data recovery work at 41CV595 (see Chapter 1).

SITE SETTING

The geomorphic setting of 41CV595 is discussed under Previous Investigations below but is summarized briefly here. Site 41CV595 is on an outcrop of Paluxy sands within the sloping upland Killeen surface immediately west of Stampede Creek. On the west side of the creek, the Paluxy Formation and the band of redeposited sandy sediments trends north-south, parallelling the creek at an approximate elevation of between 250 and 265 m (830 to 880 ft) above mean sea level. The site encompasses an area of approximately 130x125 m within this sandy band. The creek, situated only 20–30 m east of the site, flows southward about 3.75 km to its confluence with Cowhouse Creek. Walnut clay limestone crops out on the upslope (western) end of the site, and Glen Rose limestone is exposed on the downslope (eastern) end of the site. From the site, the high upland Manning surface is situated only 1.5 km to the northeast at its closest point. The vegetation cover was altered significantly during the 1996 firebreak blading, but three large oak trees within the site area survived.

PREVIOUS INVESTIGATIONS

Survey and Monitoring

On 30 April 1984, Thomas (Fort Hood) recorded the site as field number 662, and it was later assigned the trinomial number 41CV595 (site form on file, Cultural Resources Management Program office, Fort Hood). Situated immediately south of Manning Mountain Road and west of Stampede Creek, Thomas noted "highly variable concentrations of burned rocks and chert tools limited to the sandy slope," and collected three dart points. No site dimensions or sketch map were included, and the extent of the site north of the road was unknown. Off-road traffic and a major tank trail paralleling Manning Mountain Road affected approximately 15 percent of the area.

On 25 April 1985, Mesrobian and Michaels (Texas A&M) re-recorded the site as part of the Fiscal Year 1985 archeological survey of northwestern training area (Carlson et al. 1988:160; site form on file, Cultural Resources Management Program office, Fort Hood). They described it as a possible camp based on the density of burned rocks and number of dart points. Maximum site dimensions were estimated to be 120x110 m, and the deposits were up to 50 cm thick. The northern site boundary was south of and paralleled Manning Mountain Road. A burned rock mound was depicted near the north-central site margin, and a possible hearth was noted. Bifaces, debitage, and burned rocks were observed; collected artifacts consisted of 12 dart points, 1 quartzite hammerstone, and 1 mano. Eight diagnostic artifacts corresponded to the Late Archaic period (Figure 7.1). Tracked and wheeled vehicles and military maneuvers affected an estimated 60 percent of the site. Although the area was damaged, the site was considered to be in fairly good condition, and the sediments appeared to be sufficiently intact to justify test excavations.

Pry and Callum (Texas A&M University) monitored the site on 2 February 1988 (monitoring form on file, Cultural Resources Management Program office, Fort Hood). The site dimensions established in 1985 were confirmed, and one chopper was collected. Tracked and wheeled vehicles, roads, erosion, juniper cutting, and scraping damaged 85 percent of the area. Scraping had obliterated the previously recorded burned rock mound. The investigators stated, "Because of the high profile of this area, preservation from traffic does not seem likely. Immediate mitigation would be the best response." They felt that the depth of the fill and concentrations of cultural materials justified excavation before the site was completely destroyed.

Reconnaissance Survey and Shovel Testing

On 13 February 1992, Mires and Frederick (Mariah Associates) visited and evaluated the site. Based on the extent of cultural materials, the site size recorded in 1985 was reduced slightly to 120 m north-south by 90 m east-west.

The site was situated on a gentle slope and within a sandy soil derived from weathered Paluxy Formation, which in the vicinity of the site approached 4 m thick. Several burned rock concentrations, ranging from 2 to 31 m in size, were exposed in and along roads, but none were formally designated as features. Soil probes revealed an A-E-Bw-Bt-R profile, and one probe encountered charcoal at 25 cm. Burned rocks and lithic artifacts appeared to be shallowly buried in the A and E horizons. Near the northeast site margin and beside the south edge of a tank trail, a gully inset into an older soil was filled with a considerable amount of cultural materials. This profile revealed a buried soil (2Ab horizon) at approximately 35 to 100 cm. Extensive vehicle traffic had churned much of the upper deposits, and clearly more than 50 percent of the area was affected. Because the site had the potential for buried cultural deposits, shovel testing was warranted.

On 4 March 1992, a Mariah Associates crew excavated 13 shovel tests. The tests were terminated between 10 and 100 cm, and 7 were devoid of cultural materials. Six positive tests produced 55 flakes, 1 bone fragment, 1 mussel shell, and many burned rocks to a maximum depth of 80 cm, but most of the artifacts occurred at 10–20 cm. One piece of rubber or plastic also was found at 40–50 cm. One shovel test placed near the north site margin yielded charcoal-stained sediment and burned rocks from 10 to 50 cm, and another layer of burned rocks at 60–80 cm. There were 31 flakes at 0–50 cm, with 21 flakes recovered from the upper 20 cm of deposit. Although the site had been damaged by vehicle traffic, the shovel testing results indicated there might be in situ archeological deposits present. Recommended testing to determine National Register eligibility consisted of a minimum of 3 to 5 backhoe trenches and 6 to 8 m^2 of manually excavated test units (Trierweiler 1994:A965–A968).

National Register Testing

Mariah Associates conducted National Register-eligibility testing at 41CV595 in August 1993, at which time the site was mapped and site size was redefined as 130x125 m (Abbott and Trierweiler, eds. 1995:472–483). The excavations consisted of four backhoe trenches (Backhoe Trenches 1–4) and four 1x1-m test pits (Test Pits 1–4), with a total of 3.5 m^3 hand excavated (Figure 7.2). The trenches ranged from 5 to 32 m long, were 0.80 m wide, and had maximum depths between 1.7 and 2.2 m. Near the north central site margin, Backhoe Trenches 1 and 2 crossed dense areas of burned rocks later designated Features 1 and 2 (burned rock middens). Backhoe Trenches 3 and 4 were placed southwest (upslope) and southeast (downslope) of Backhoe Trench 2. One Pedernales (correctly

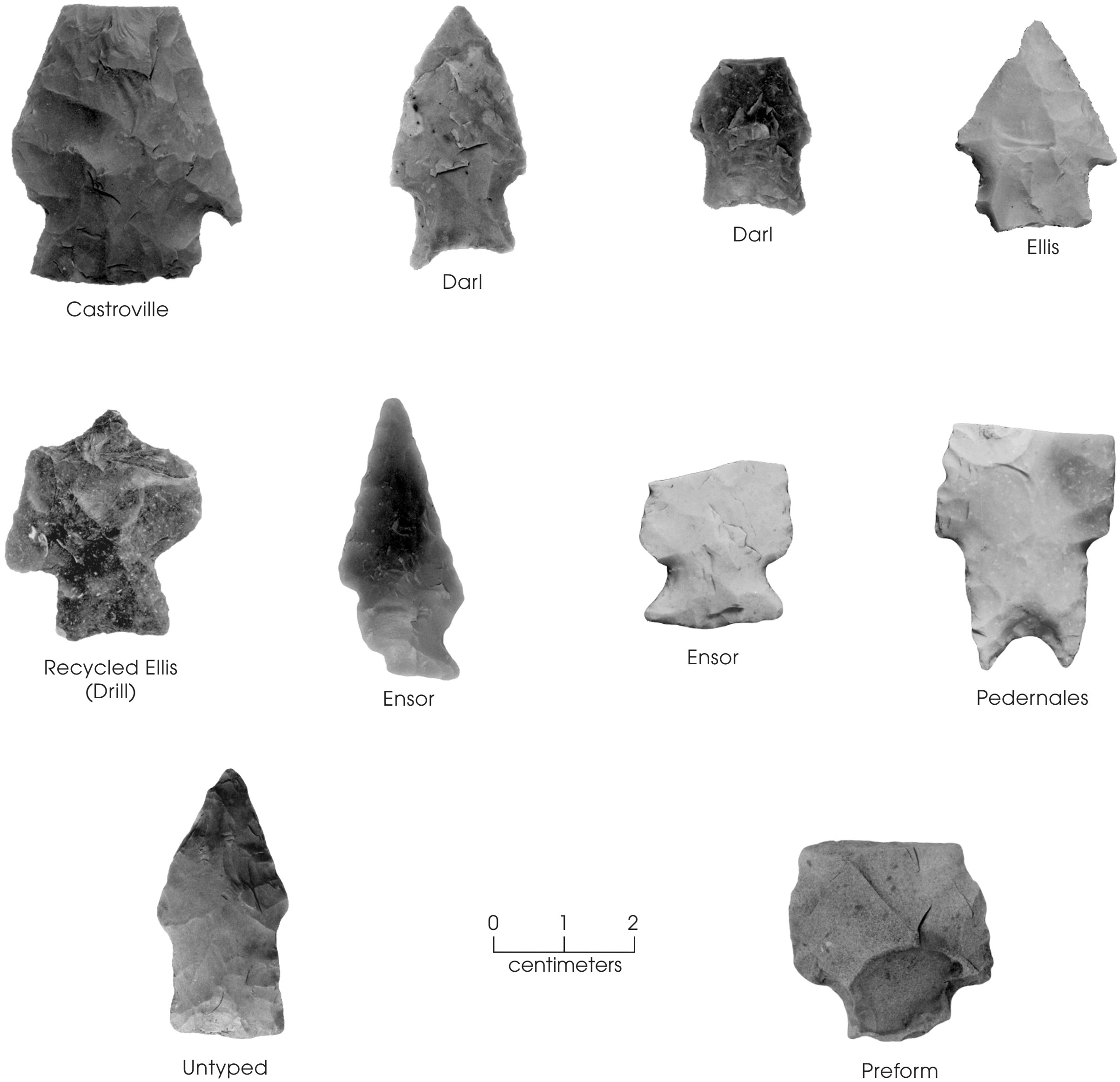


Figure 7.1. Dart points and preform, Texas A&M University surface collections, 41CV595.

identified as a Pedernales in artifact data microfiche [Abbott and Trierweiler 1995:Appendix C] but misidentified as a Marshall in the site testing report [Abbott and Trierweiler 1995:479, Table 6.60]) and one untyped dart point were collected from the surface (Figure 7.3).

Variable profiles in backhoe trenches and natural exposures suggested that colluvial deposition and pedogenesis followed three periods of gully formation and erosion. One erosion cycle occurred during the late Holocene at the time of site occupation, but the other two cycles took place much earlier—probably during the late Pleistocene to early Holocene, based on the degree of soil development. Different aged deposits were characterized as Units 1 to 3 from oldest to youngest.

The youngest deposit, termed Unit 3, consisted of the modern soil, which was usually less than 20 cm thick and exhibited an A or A-E profile. The E horizon occurred only when the A horizon was thicker than 20 cm. Where there were paleo-gullies, Holocene sediments were up to 180 cm thick and included a very weak Bk horizon (e.g., Backhoe Trench 1). The entire sequence consisted of loose to friable, very dark grayish brown loamy sand to sandy loam.

Sediments corresponding to Unit 2 were 80

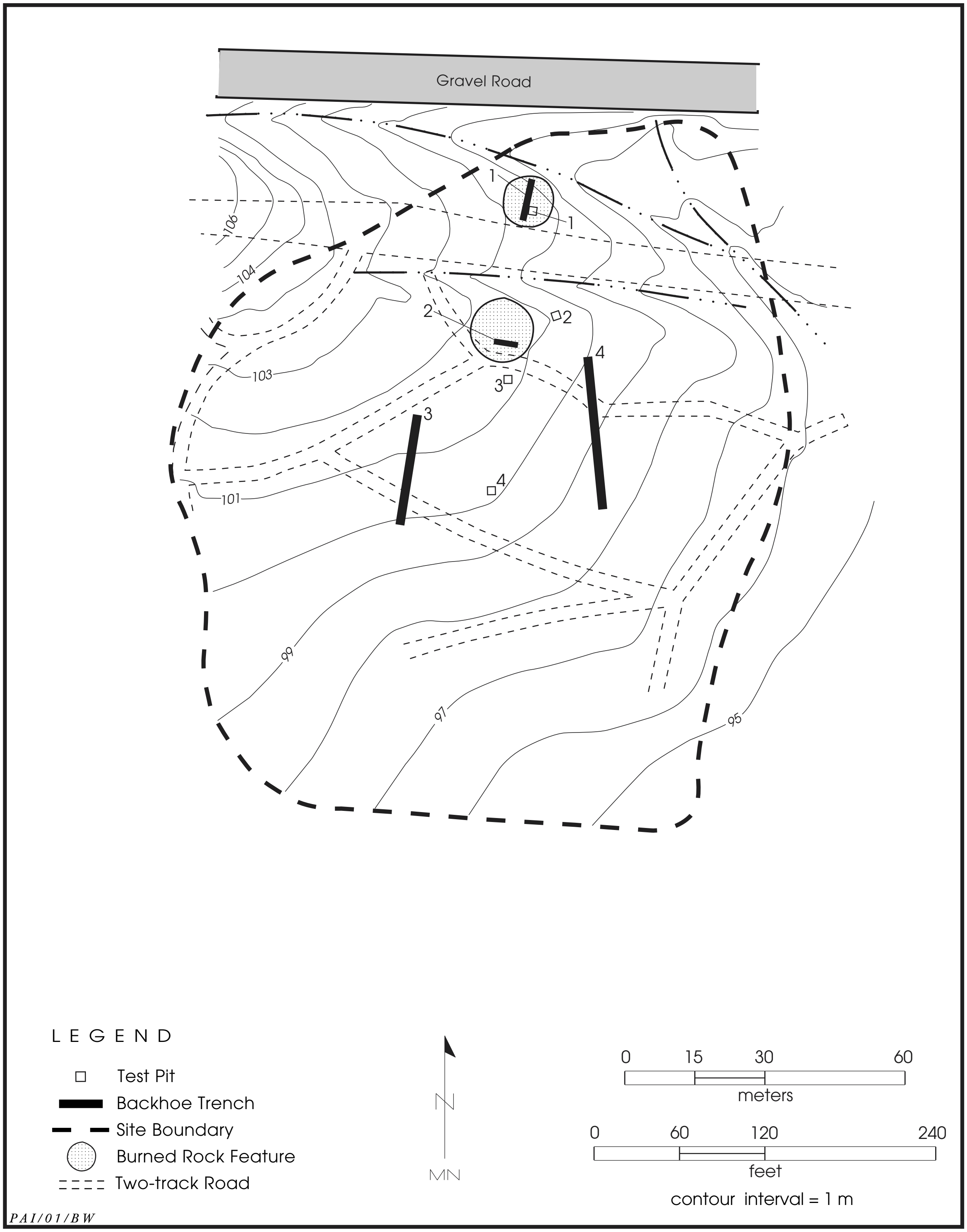


Figure 7.2. Mariah Associates site map of 41CV595 (modified from Abbott and Trierweiler, eds. 1995:473).

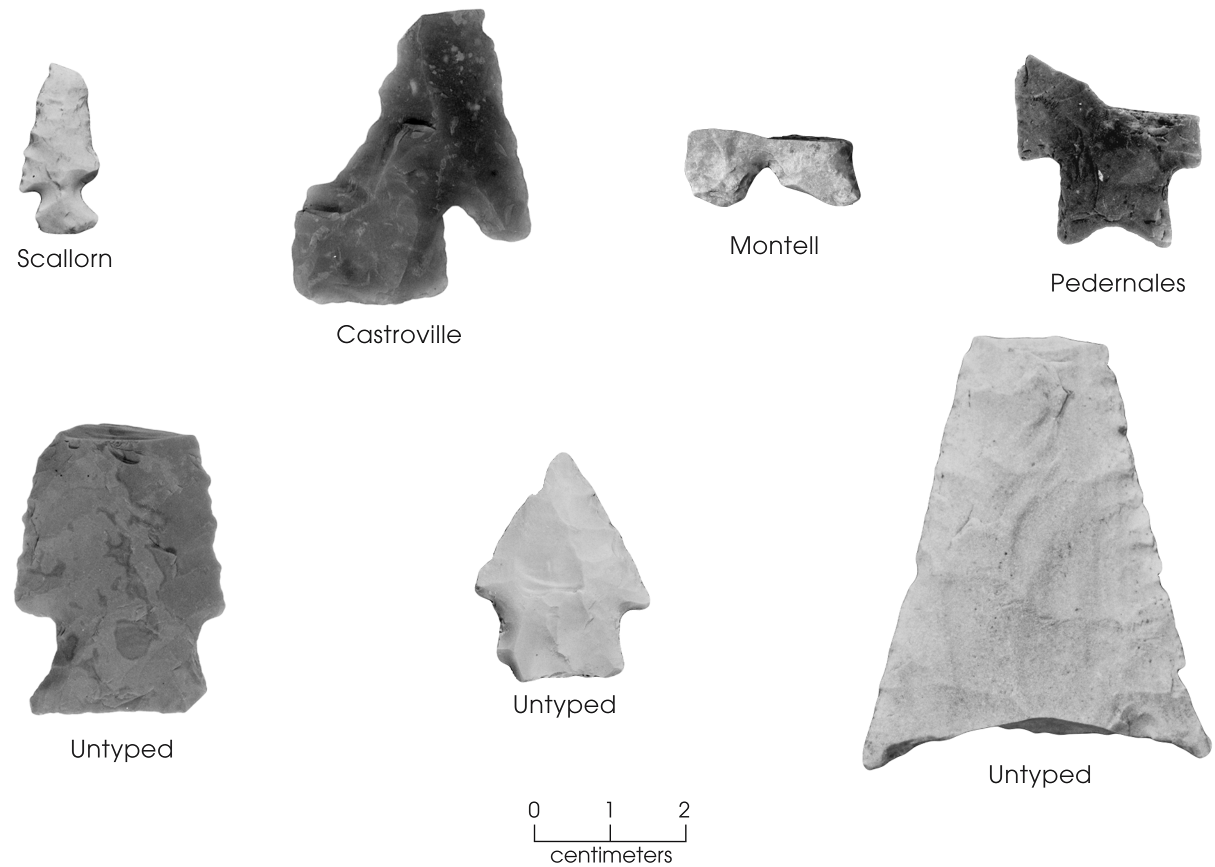


Figure 7.3. Arrow and dart points, Mariah Associates collections, 41CV595.

to 160 cm thick. The soil consisted of a yellowish red sandy clay Bt horizon grading with depth into a reddish yellow to yellow sand and loamy sand (BC horizon). Cultural materials in the upper 20 cm of the Bt horizon were thought to indicate sedimentation during the Holocene or reworking of materials, possibly through bioturbation. The base of Unit 2 terminated on a prominent, abrupt, wavy boundary with either Unit 1 or pedogenically unmodified Paluxy sand. The presence of distinct, rounded fragments of Paluxy sand near the bottom of the unit suggested an erosional event occurred during initial deposition of the unit. Gullies probably also were associated with this event based on undulations in the lower boundary.

Unit 1 exhibited a Bk-BC profile. The Bk horizon was a reddish yellow to yellowish red loamy sand and sand containing filamentous and some nodular carbonates. Erosion had clearly truncated the top of this soil. In Backhoe Trench 3, Unit 3 was 30 to 170 cm thick, with the deposit filling prominent gullies that downcut the unweathered Paluxy sand. In contrast, the unit in Backhoe Trench 4 graded into the parent material. This formation ranged from white to brownish yellow and was often thinly bedded or laminated.

Placed along the southeast edge of Backhoe Trench 1, Test Pit 1 was culturally sterile at 0–10 cm. Feature 1 (burned rock midden) was encountered from 10 to 110 cm and produced stone artifacts, unmodified bones, burned rocks, and charcoal (Table 7.1). In general, burned rock counts decreased with depth, but rock size increased. Gravels present in the upper 30 to 35 cm of the feature fill were probably introduced by road construction and tank traffic. Large pieces of unburned (possibly colluvial) limestone were noted in the lower 40 cm of the midden. Two charcoal samples yielded stratigraphically reversed, conventional radiocarbon ages of 1,240 ± 70 and 920 ± 80 B.P. Two suites of A/I ratios on *Rabdotus* snail shells associated with the radiocarbon ages were equivalent. The excavation results and surface exposure indicated

Table 7.1. Summary of cultural materials Mariah Associates recovered from 41CV595

	Artifacts				Faunal Remains	Burned Rocks	
Provenience	Projectile points	Stone tools	Unmodified debitage	Artifact total	Unmodified bones	Count	Weight (kg)
Surface Collection	2	0	0	2	0	0	0.00
Test Pit 1							
Feature 1 (10–20 cm)	–	–	3	3	–	150	14.00
Feature 1 (20–30 cm)	–	–	5	5	–	70	10.00
Feature 1 (30–40 cm)	–	1	1	2	1	80	11.50
Feature 1 (40–50 cm)	–	–	–	–	–	40	8.50
Feature 1 (50–60 cm)	–	–	1	1	–	30	17.00
Feature 1 (60–70 cm)	–	–	1	1	–	25	10.00
Feature 1 (70–80 cm)	–	1	1	2	–	15	7.50
Feature 1 (80–90 cm)	–	–	1	1	–	15	5.80
Feature 1 (90–100 cm)	–	–	–	–	4	8	3.00
Feature 1 (100–110 cm)	–	2	94	96	1	20	17.00
Subtotal	0	4	107	111	6	453	104.30
Level 1 (0–10 cm)	–	–	–	–	–	–	–
Level 12 (110–120 cm)	–	–	–	–	–	3	0.30
Level 13 (120–130 cm)	–	–	1	1	–	7	5.00
Level 14 (130–140 cm)	–	–	1	1	14	6	3.50
Level 15 (140–150 cm)	–	–	–	–	–	4	0.80
Level 16 (150–160 cm)	–	–	–	–	–	–	–
Subtotal	0	0	2	2	14	20	9.60
Test Pit 1 Subtotal	0	4	109	113	20	473	113.90
Test Pit 2							
Feature 2 (0–10 cm)	–	–	5	5	–	5	0.50
Feature 2 (10–20 cm)	–	–	12	12	6	8	0.50
Feature 2 (20–30 cm)	–	–	15	15	–	8	1.50
Feature 2 (30–40 cm)	–	–	9	9	–	11	1.50
Feature 2 (40–50 cm)	–	–	17	17	–	15	2.50
Feature 2 (50–60 cm)	–	1	8	9	–	40	37.50
Feature 2 (60–70 cm)	1	–	2	3	–	10	2.00
Subtotal	1	1	68	70	6	97	46.00
Level 8 (70–80 cm)	–	–	6	6	0	0	0.00
Test Pit 2 Subtotal	1	1	74	76	6	97	46.00
Test Pit 3							
Feature 2 (0–10 cm)	–	–	5	5	–	23	3.30
Feature 2 (10–20 cm)	–	–	6	6	–	8	1.70
Feature 2 (20–30 cm)	2	4	95	101	–	53	5.30
Feature 2 (30–40 cm)	1	1	69	71	–	67	12.50
Feature 2 (40–50 cm)	–	2	29	31	3	28	3.50
Feature 2 (50–60 cm)	–	–	25	25	–	10	1.20
Feature 2 (60–70 cm)	–	–	3	3	–	3	0.30
Subtotal	3	7	232	242	3	192	27.80
Level 8 (70–80 cm)	–	–	–	–	–	–	0.00
Test Pit 3 Subtotal	3	7	232	242	3	192	27.80
Test Pit 4							
Level 1 (0–10 cm)	1	–	14	15	–	–	–
Level 2 (10–20 cm)	–	1	30	31	–	–	–

Table 7.1, continued

Provenience	Artifacts				Faunal Remains	Burned Rocks	
	Projectile points	Stone tools	Unmodified debitage	Artifact total	Unmodified bones	Count	Weight (kg)
Level 3 (20–30 cm)	–	–	13	13	–	1	0.10
Test Pit 4 Subtotal	1	1	57	59	0	1	0.10
Total	5	13	472	490	29	763	187.80

Note: Data are from Abbott and Trierweiler, eds. 1995:Table 6.69 and Appendix C, Artifact Data Microfiche.

that Feature 1 measured 11 m in diameter and was 1 m thick. Four of five levels excavated below Feature 1 contained scattered cultural materials.

Test Pits 2 and 3 were situated just east and south of the surface manifestation of Feature 2. Both excavations encountered the burned rock midden from the surface to 70 cm, and stone artifacts, unmodified bones, and burned rocks were found in the deposits. In Test Pit 2, sparse gravels and a few pieces of unburned limestone occurred in the upper 20 cm of feature fill. In this excavation, the number of burned rocks increased with depth, and an untyped dart point was found at the base of the midden. In Test Pit 3, burned rock counts peaked near the center of the feature, then substantially diminished with depth. One Scallorn arrow point and a Castroville dart point were found at 20–30 cm. A charcoal sample obtained at 40–50 cm yielded a conventional radiocarbon age of 1860 ± 80 B.P. This level also contained a Montell dart point. As mapped, the surface extent of Feature 2 was 14 m in diameter, but the investigators enlarged the 70-cm-thick midden dimensions to approximately 20 m east-west by 18 m north-south, based on the results of Test Units 2 and 3. Some flakes were found in Level 8 below the midden.

Test Pit 4 was situated south of Test Pit 3 and equidistant from Backhoe Trenches 3 and 4. Three levels excavated from the surface to 30 cm produced a moderate amount of debitage, along with a few stone tools (including an untyped dart point) and a burned rock.

The investigations revealed the presence of two discrete burned rock middens spaced approximately 15 m apart. Feature 2 contained more artifacts than Feature 1. Radiocarbon assays and diagnostic artifacts recovered from these two features demonstrate use during the Late Archaic and Late Prehistoric (Austin phase) periods. Although the artifact assemblage consisted of a wide variety of chert types representing all four provinces identified at Fort Hood, the North Fort province made up more than half of the assemblage and was dominated by Fort Hood Yellow. The lithic materials included formal and expedient tools, and the debitage analysis primarily indicated late-stage reduction. Deer-sized mammal and cottontail rabbit made up the identified faunal remains. Although the upper 20 cm of the site's deposits appeared disturbed, intact cultural components were found at greater depths and were affected only minimally by bioturbation. Based on the testing results, 41CV595 was recommended as eligible for listing in the National Register.

Damage Assessment and Site Evaluation

Huckerby and Kleinbach visited 41CV595 on 23 March 1998 because creation of an emergency firebreak during a 1996 wildfire at Fort Hood (Huckerby 1998b) damaged the National Register-eligible site. Bulldozers cleared most of 41CV595 by pushing vegetation from the north edge of the site across the area to the south. An estimated 80 to 90 percent of the site was damaged during the 1995 firebreak blading. Disturbance was observed to a maximum depth of 50 cm, most notably where larger trees were uprooted. Bulldozer tracks severely disturbed the upper 10–15 cm of deposits, and in some areas bedrock was later exposed. During the 1998 site visit, tank tracks were also visible across the area. Active erosion, shown by redeposition of sediments in gullies and down cutting, particularly along a tank trail, was an ongoing threat. Nonetheless, there was potential for intact subsurface deposits in deeper portions of the site. Large oak trees also protected a 25x8-m area along the northern site margin and an area near the south end of the site. Because no vegetation clearing took place in these areas, they appeared relatively intact.

The investigators concluded, "Considering the site's location and the level of military activity in the area of the site, a constructed recovery plan should be developed to examine the site's contents in context with Fort Hood's *Significant Standards for Prehistoric Cultural Resources* particularly since this site contains burnt rock mounds in Paluxy sands not identified in other areas of Fort Hood" (Huckerby 1998b:6).

WORK ACCOMPLISHED

The additional testing and data recovery investigations are presented together for ease of discussion and because the same field methods were employed during both phases of fieldwork (see Chapter 4 for a discussion of field methods employed at 41CV595). Because the data recovery work involves contiguous units and block excavations, no measurements are given as depth below surface as was done for the additional testing work at 41CV988 (Chapter 5) and 41CV1141 (Chapter 6). The vertical control used in the field at 41CV595 was maintained using elevations determined in relation to a primary datum point with an assigned arbitrary elevation of 100 m. In this and all following chapters, all vertical provenience information is presented as elevations. The depth below surface, as measured during the data recovery effort, can be very misleading at this site because of the extensive disturbances and the removal of deposits over large areas (this is particularly true for Area 2).

Archeological investigations were conducted at 41CV595 from July to September 2000 (Figure 7.4), and the site was named the Firebreak site during the course of this work. The first task at 41CV595 was a reconnaissance of the site area to look for remnants of the previously recorded features and past excavations. Burned rocks and debitage were scattered in the general areas where the features were documented in 1993, but no indications of burned rock middens were apparent. None of the previously excavated backhoe trenches (Backhoe Trenches 1–4) or test pits (Test Pits 1–4) could be located again because site damage was extensive. But the 25x8-m undisturbed area Huckerby noted in 1998 was re-located and found to be in good shape. Dense burned rocks observed on this surface appeared to represent an unrecorded feature.

Both mechanical and manual excavations were conducted at 41CV595 (Figure 7.4). One Gradall and eight backhoe trenches were placed across the site to identify areas with buried, intact cultural deposits (Table 7.2). The trenches vary in depth from 25 to 160 cm, and all were excavated until they reached the Bt soil horizon (Stratum II) that marks the old late Pleistocene or early Holocene surface. Backhoe Trench 5 was placed north of the heavily used east-west tank trail and consisted entirely of road fill, and Backhoe Trenches 10–12, situated near the southern site margin, were devoid of cultural materials. Although cultural materials were encountered in one Gradall and four backhoe trenches, Backhoe Trenches 6, 7, and 8 contained burned rock features and associated artifacts. These three trenches revealed areas with high archeological research potential, and hand excavations were undertaken at these locations (Table 7.3). Because distinct types of cultural activities may have occurred in these spatially discrete locales, they were designated Areas 1, 2, and 3.

Area 1, situated on a 15-m-wide strip wedged between a tank trail and a gully near the northern site margin, was investigated with Backhoe Trench 6 and Test Units 5–7 (see Figure 7.4). Evidence of Backhoe Trench 1 and Test Pit 1 (both excavated in 1993) was visible near the midpoint of Backhoe Trench 6 in both the north and south walls. Although this trench bisected these earlier excavations in the area where Feature 1 was found, some cultural materials were present, but no burned rock midden deposits were observed. Consequently, it appears that Backhoe Trench 6 just skirted the edge of the main concentration of cultural materials that was previously called a burned rock midden.

A burned rock concentration, designated as Feature 6, was found at approximately 110 cm in Backhoe Trench 6, and a metate collected from the trench backdirt may have been associated with this feature. The three contiguous test units were placed at the northwest corner of Backhoe Trench 6 over the point where Feature 6 was exposed. At this location, some artificial fill was removed by the backhoe, but the test units exposed 100–110 cm of intact sediment below the artificial fill. A total of 3.2 m^3 of cultural deposits was manually removed from the three units.

Area 2 was defined as the center of the site where Feature 2, a burned rock midden, was previously discovered. In this area, Backhoe Trench 8 exposed dense burned rocks and some

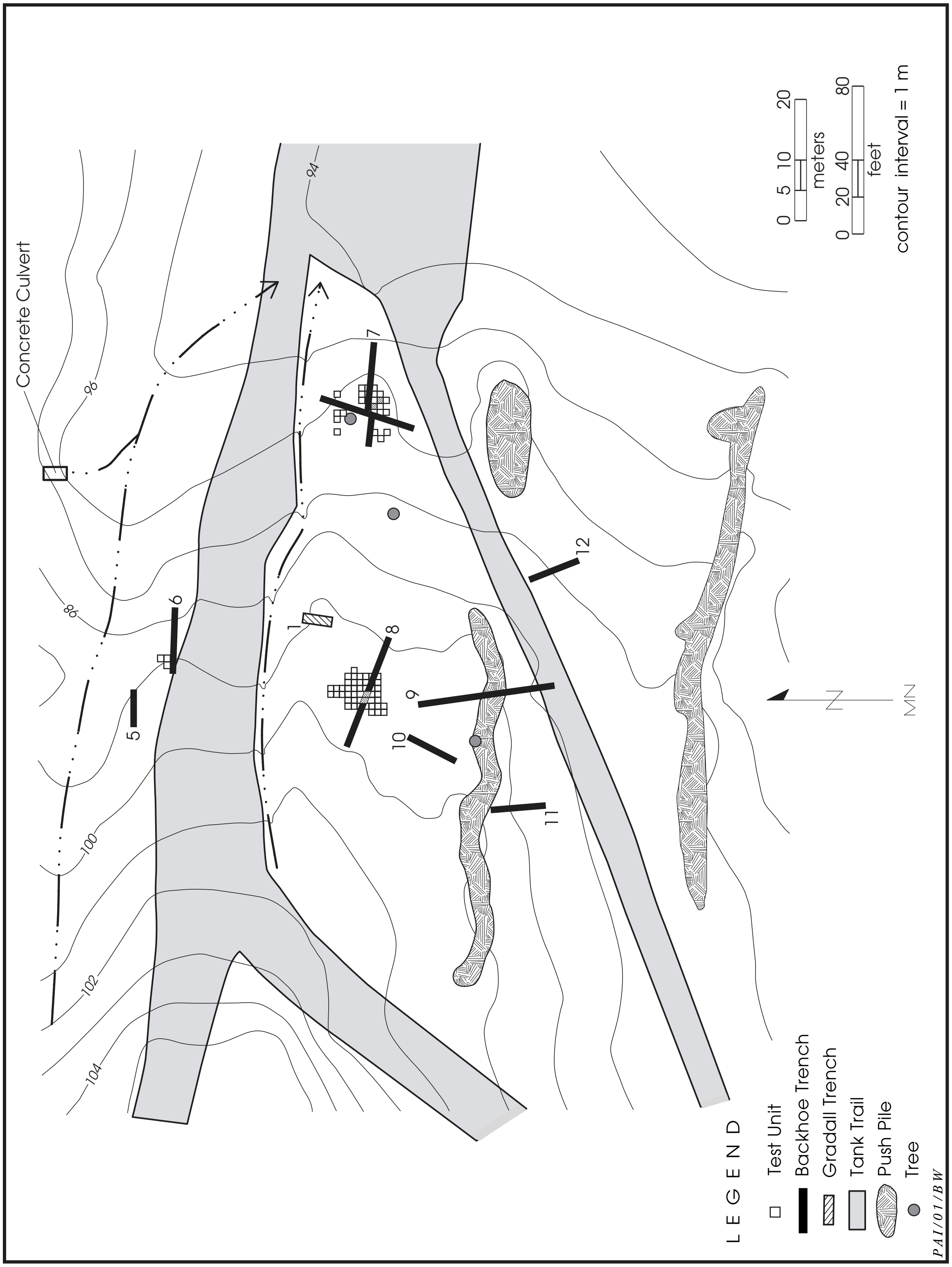


Figure 7.4. Site map of 41CV595.

Table 7.2. Summary of backhoe and Gradall trenches, 41CV595

Trench*	Dimensions (m)	Results
Gradall Trench 1	4.0x1.55x1.4	scattered burned rocks from surface to 60 cm
Backhoe Trench 5	5.5x0.7x0.9	road fill
Backhoe Trench 6	10.0x0.7x1.6	probable hearth at ca. 110 cm; associated metate collected from backdirt
Backhoe Trench 7	X-shaped trench 16x0.7x0.7 north-south, 16x0.7x0.7 east-west	trench bisects Feature 3 (burned rock mound) in both directions; Feature 3 extends from surface to 60 cm with an internal feature exposed at ca. 50 cm
Backhoe Trench 8	19.0x0.7x1.25	burned rocks from surface to 40 cm; probable hearth at ca. 20 cm
Backhoe Trench 9	23.0x0.7x0.7	occasional burned rocks at 25–50 cm; trench crossed a linear vegetation push pile
Backhoe Trench 10	8.7x0.7x1.2	–
Backhoe Trench 11	9.1x0.7x1.2	–
Backhoe Trench 12	8.7x0.7x0.25	–

Note: Backhoe Trenches 1–4 were excavated in 1993.

debitage from the surface to 40 cm, particularly toward the east (downslope) end of the trench. These cultural materials may represent what remained of the midden after the surface was stripped away during the 1996 firebreak blading incident. Burned rocks that appeared to represent a hearth, later designated as Feature 8, were encountered at 20 cm in the central portion of the trench. Much of the data recovery work focused in Area 2, and excavations were expanded into a single excavation block comprising 45 contiguous units (Test Units 8–52) north and south of Backhoe Trench 8. A total of 20.49 m^3 of cultural deposits was manually excavated in Area 2, and individual units ranged between 15 and 85 cm in depth. The west end of Backhoe Trench 2, excavated by Mariah Associates archeologists in 1993, was encountered along the north edge of Test Units 18 and 19. The trench cut was visible in the north walls of both units for a maximum length of 175 cm and extended south into the excavations as a narrow 10-to-25-cm wide strip.

Area 3 was in the east-central, downslope margin of the site that appeared undisturbed by the firebreak blading. Placed east and south of a large post oak tree, an X-shaped trench (Backhoe Trench 7) exposed dense burned rocks and dark loamy sediments from surface to 60 cm. This deposit was designated Feature 3, and its domed morphology indicated that it represented an isolated burned rock mound. The edges of the feature were clearly delineated by the contact of the anthropogenic deposits and the much lighter Paluxy sediments. Burned rocks were scattered from the surface to 20 cm in the surrounding, nonfeature fill. Within the mound, larger burned rocks exposed at 20–30 cm in the south wall on the east-west trench segment appeared to be an internal hearth (Feature 4). One Ensor dart point was collected from the backdirt of Backhoe Trench 7. Nineteen test units (Test Units 53–71) were located on and beside Feature 3, and about half of the excavations centered around Feature 4. Many, but not all, of the units were contiguous. A total of 11.98 m^3 of cultural deposits, which varied from 25 to 95 cm thick, was removed manually.

The data recovery excavations at 41CV595 concentrated on three primary areas and recovered 3,394 artifacts (Table 7.4). Including artifacts found in previous phases of work, the site has yielded 32 temporally diagnostic projectile points. A total of 16 features were documented in all phases of work (Table 7.5). Of these, 15 consisted primarily of burned rocks. Features 1, 2, and 3 are burned rock middens or mounds; Features 4, 8, 11, and 15 are large cooking pits or earth ovens; Features 6, 12, and 14 are smaller hearths; Features 5, 9, 10, and 13 are burned

Table 7.3. Summary of all hand-excavated units, 41CV595

Grid Coordinates	Test Unit	Unit Size (m)	Starting Elevation (m)	Ending Elevation (m)	Excavated Volume (m^3)	Comments
AREA 1						
N1035 E1014	5	–	98.70	97.60	1.10	excludes 10–15 cm of artificial fill removed by backhoe
N1034 E1013	6		98.86	98.00	1.08	excludes 40–50 cm of artificial fill removed by backhoe
N1034 E1014	7	1.25x1.0	98.82	98.00	1.02	excludes 30 cm of artificial fill removed by backhoe
Area 1 Subtotal					3.20	
AREA 2						
N1006 E1008	8	–	99.50	99.30	0.20	
N1006 E1009	9	–	99.45	99.20	0.25	
N1005 E1008	10	–	99.65	99.30	0.35	
N1005 E1009	11	–	99.67	99.20	0.30	17 cm of disturbed soil not screened
N1004 E1008	12	–	99.65	99.20	0.45	
N1004 E1009	13	–	99.66	99.10	0.56	modern items in upper 20 cm
N1003 E1006	14	–	99.61	99.30	0.24	5–10 cm of disturbed soil not screened
N1003 E1007	15	–	99.60	99.20	0.37	1–5 cm of disturbed soil not screened
N1003 E1008	16	–	99.63	99.20	0.43	
N1003 E1009	17	–	99.65	99.10	0.50	5 cm of disturbed soil not screened
N1003 E1010	18	–	99.57	99.10	0.47	
N1003 E1011	19	–	99.49	99.10	0.39	
N1002 E1006	20	–	99.67	99.30	0.37	
N1002 E1007	21	–	99.68	99.20	0.48	
N1002 E1008	22	–	99.70	99.10	0.50	10 cm of disturbed soil not screened
N1002 E1009	23	–	99.61	99.10	0.44	5–10 cm of disturbed soil not screened
N1002 E1010	24	–	99.55	99.10	0.43	1–4 cm of disturbed soil not screened
N1002 E1011	25	–	99.55	99.00	0.55	
N1002 E1012	26	–	99.54	99.10	0.44	
N1001 E1006	27	1.0x0.5	99.67	99.20	0.23	
N1001 E1007	28	–	99.71	99.20	0.38	11–16 cm of disturbed soil not screened
N1001 E1008	29	1.5x1.0	99.70	99.10	0.72	11–14 cm of disturbed soil not screened
N1001 E1009	30	–	99.60	99.10	0.50	
N1001 E1010	31	–	99.50	99.10	0.35	2–8 cm of disturbed soil not screened
N1001 E1011	32	–	99.47	99.00	0.47	
N1000 E1006	33	1.0x0.8	99.65	99.20	0.26	1–23 cm of disturbed soil not screened
N1000 E1009	34	1.0x0.8	99.61	99.10	0.41	
N1000 E1010	35	–	99.44	99.10	0.34	
N1000 E1011	36	–	99.38	98.90	0.48	modern items in upper 20 cm
N999 E1005	37	–	99.70	99.20	0.44	2–11 cm of disturbed soil not screened
N999 E1006	38	–	99.68	99.10	0.48	6–15 cm of disturbed soil not screened
N999 E1007	39	1.3x1.0	99.70	99.10	0.64	6–16 cm of disturbed soil not screened

Table 7.3, continued

Grid Coordinates	Test Unit	Unit Size (m)	Starting Elevation (m)	Ending Elevation (m)	Excavated Volume (m^3)	Comments
N999 E1008	40	–	99.66	99.00	0.50	13–20 cm of disturbed soil not screened
N999 E1009	41	1.0x0.8	99.50	99.00	0.33	8–11 cm of disturbed soil not screened
N999 E1010	42	–	99.44	98.90	0.54	
N999 E1011	43	–	99.28	98.80	0.48	
N998 E1005	44	–	99.65	99.20	0.38	7 cm of disturbed soil not screened
N998 E1006	45	–	99.77	99.10	0.56	5–17 cm of disturbed soil not screened
N998 E1007	46	–	99.77	99.00	0.64	9–17 cm of disturbed soil not screened
N998 E1008	47	–	99.64	98.80	0.68	12–20 cm of disturbed soil not screened
N998 E1009	48	–	99.50	98.80	0.58	8–16 cm of disturbed soil not screened
N998 E1010	49	–	99.46	98.60	0.77	2–16 cm of disturbed soil not screened
N998 E1011	50	–	99.38	98.70	0.65	2–4 cm of disturbed soil not screened
N997 E1005	51	–	99.60	99.10	0.43	4–11 cm of disturbed soil not screened
N997 E1006	52	–	99.80	99.10	0.53	15–20 cm of disturbed soil not screened
Area 2 Subtotal					20.49	
AREA 3						
N1004 E1052	53	–	96.24	95.80	0.44	
N1004 E1054	54	–	96.28	95.80	0.48	
N1004 E1055	55	–	96.27	95.70	0.57	
N1004 E1058	56	–	96.18	95.50	0.68	
N1003 E1055	57	–	96.30	95.60	0.70	
N1001 E1057	58	1.2x1.0	96.26	95.60	0.79	
N1001 E1058	59	1.35x1.0	96.28	95.50	1.05	
N1001 E1059	60	–	96.18	95.22	0.96	
N1000 E1059	61	1.0x0.5	96.25	95.40	0.43	
N999 E1052	62	1.0x0.5	96.37	95.80	0.29	
N999 E1057	63	–	96.24	95.55	0.69	
N999 E1058	64	–	96.24	95.55	0.69	
N999 E1059	65	–	96.20	95.55	0.65	
N998 E1051	66	–	96.27	95.90	0.37	
N998 E1056	67	–	96.22	95.52	0.70	
N998 E1058	68	–	96.24	95.50	0.74	
N997 E1052	69	–	96.27	95.80	0.47	
N997 E1055	70	–	96.20	95.60	0.60	
N997 E1057	71	–	96.18	95.50	0.68	
Area 3 Subtotal					11.98	
Total					35.67	

Notes: Test Pits 1–4 were excavated during testing in 1993. Unless noted otherwise, all units measure 1x1 m. Starting elevation is ground surface for all units. Excavated volumes exclude sediments that were not screened.

Table 7.4. Summary of artifacts, 41CV595, by area

Artifact Group	Area 1	Area 2	Area 3	Total
Arrow point	–	–	4	4
Arrow point preform	–	1	–	1
Dart point	–	15	10	25
Dart point preform	–	–	1	1
Perforator	–	–	1	1
Early to middle-stage biface	–	10	11	21
Late-stage to finished biface	–	7	4	11
Miscellaneous biface	–	1	–	1
End scraper	–	1	1	2
Side scraper	–	1	–	1
Miscellaneous uniface	–	3	1	4
Spoke shave	–	1	1	2
Burin	–	3	–	3
Core tool	–	1	1	2
Edge-modified flake	3	20	16	39
Core	3	12	2	17
Tested Cobble	1	–	–	1
Unmodified debitage	114	1,999	1,140	3,253
Metate	1	1	–	2
Other ground stone	–	2	–	2
Hammerstone	1	–	–	1
Total	123	2,078	1,193	3,394

rock concentrations, and Feature 7 is a general burned rock scatter or cultural zone. Perhaps most intriguing, the sixteenth feature is a large circular cluster of unburned limestone rocks. Previous investigators obtained three radiocarbon dates, and 12 more radiocarbon dates were obtained during data recovery (Table 7.6).

The excavations by Prewitt and Associates in 2000 overlap the previous excavations by Mariah and Associates in 1993 in some places, particularly in Areas 1 and 2 (Figure 7.5). Because there are extensive disturbances from the 1996 firebreak clearing, the previous excavations could not be found on the surface, and their discovery in the data recovery excavations was fortuitous. The current work demonstrates that significant archeological deposits remain intact at 41CV595, and it is recommended that the site is still eligible for listing in the National Register of Historic Places (see Chapter 9).

SEDIMENTS AND STRATIGRAPHY

Examining trench and excavation unit profiles at 41CV595 revealed a complex late Quaternary soil-stratigraphy. Abbott and Trierweiler (1995a:475) also noted the complex stratigraphy during an earlier phase of work at the site and suggested that multiple but distinct periods of gully formation-erosion followed by colluvial deposition and pedogenesis occurred at the locality.

Abbott and Trierweiler's (1995a) Unit 3 and Kibler's (1999) Stratum I represent the most recent period of deposition at the site. The significance of this late Holocene sandy mantle is that it contains the cultural materials and features. It occurs across the entire site and varies in thickness from more than 100 cm in Backhoe Trench 6 to 27 cm in the middle of Backhoe Trench 7, suggesting that the surface it rests on was eroded and riddled with gullies. The thinner deposits exhibit an A horizon or an A/E soil profile. These thin soils consist of brown to very dark grayish brown, fine to very fine sandy loams.

In some instances an anthropogenic component—usually containing many burned and fractured rocks, ash, charcoal, and other cultural debris—is encapsulated in the deposit. In these areas, the result is a thicker, darker A horizon. Such is the case on the eastern end of the site in Test Units 58–61 and 63–65 (by the middle of

Table 7.5. Summary of features, 41CV595, by area

Feature No.	Feature Type	Association and Comments	Area 1	Area 2	Area 3
1	Burned rock midden	midden not encountered during data recovery excavations	x	–	–
2	Burned rock midden	upper part of midden destroyed by firebreak clearing; lower portion is Feature 7	–	x	–
3	Burned rock mound	mound is intact except for data recovery test units	–	–	x
4	Earth oven (cooking pit)	in center of the Feature 3 mound	–	–	x
5	Burned rock concentration, function unknown	may be part of Feature 9; possibly a dump of boiling stones or cleanout from an earth oven	–	–	x
6	Hearth (or cooking pit)	near Feature 1	x	–	–
7	Burned rock layer or cultural zone	underlies area where Feature 2 was observed	–	x	–
8	Earth oven (cooking pit)	possibly associated with Feature 2	–	x	–
9	Burned rock concentration, function unknown	may be part of Feature 5: possibly a dump of boiling stones or cleanout from an earth oven	–	–	x
10	Burned rock cluster, possibly a dump	possibly a dump of debris from stone boiling or cleanout from an earth oven	–	x	–
11	Earth oven (cooking pit)	adjoining and contemporaneous with Feature 15	–	x	–
12	Hearth		–	x	–
13	Burned rock concentration	possibly a dump of debris from cleanout of hearth Feature 12	–	x	–
14	Hearth (basin-shaped)		–	x	–
15	Earth oven (cooking pit)	adjoining and contemporaneous with Feature 11	–	x	–
16	Large circular rock cluster	possible stockpile of unburned rocks for use in cooking pits	–	x	–

Note: The Feature 7 designation was originally given to a zone of burned rocks in several units in Area 2. The designation was later dropped because the burned rock scatter was continuous across Area 2.

Backhoe Trench 7), where the A horizon comprises a ca. 69-cm-thick black silt loam with many densely packed burned rocks. Thicker late Holocene deposits lacking occupation debris are seen in areas where sediments filled in old gullies. The profile of Backhoe Trench 6, for example, reveals a thick deposit of late Holocene colluvial and slopewash sediments that fill a deep gully. The formation of the gully removed the earlier deposits by around 5000–4000 B.P., and the gully probably filled with Stratum I sediments between ca. 3500 and 500 B.P. (see Kibler 1999:51).

Backhoe Trench 6 displays a Cu-A-Bc soil profile and exposes the 1993 Mariah Associates excavations (Figure 7.6). The Cu horizon (0–20 cm) is an interbedded light yellowish brown silty clay loam and very dark grayish brown very fine sandy loam. It represents a very recent and minor colluvial and slopewash deposit at the western end of the trench that pinches out downslope (to the east). The A horizon (20–38 cm) is a dark grayish brown to very dark grayish brown fine sandy loam. It grades down profile to a Bw horizon (38–106+ cm). The Bw horizon consists of a dark grayish brown fine sandy loam with 5–10 percent limestone and sandstone gravels. Portions of the Paluxy Formation sandstone were observed at the bottom of the trench, suggesting that the gully entirely removed earlier depositional units and incised the bedrock.

Predating and underlying the late Holocene

Table 7.6. Summary of radiocarbon dates, 41CV595

Beta Sample No.	Field Sample No.	Sample Material* and Weight (g)	Provenience	Feature Association and Context	Conventional Radiocarbon Age, B.P.	$^{13}C/^{12}C$ Ratio	Radiocarbon Age Calibration, 2-sigma Range**
Dates from Data Recovery Project							
Beta-149084	C-8	charcoal, 0.1	Area 1, Test Unit 6	Feature 6, 98.07	970 ± 40	-26.1	A.D. 1000–1170
Beta-149085	C-17	charcoal, 0.4	Area 2, Test Unit 16	nonfeature, 99.48	1340 ± 40	-25.5	A.D. 640–770
Beta-149086	C-25	charcoal, 0.1	Area 2, Test Unit 29	Feature 12, 99.47	1310 ± 40	-24.1	A.D. 650–780
Beta-149087	C-28	charcoal, 0.9	Area 2, Test Unit 33	Feature 8, 99.34	1280 ± 40	-27.5	A.D. 660–860
Beta-149088	C-30	charcoal, 0.3	Area 2, Test Unit 34	Feature 11, 99.16	2050 ± 40	-25.7	170 B.C.– A.D. 40
Beta-149089	C-35	charcoal, 0.6	Area 2, Test Unit 35	Feature 11, 99.07	2140 ± 40	-25.5	360–50 B.C.
Beta-149090	C-39	charcoal, 0.8	Area 2, Test Unit 52	Feature 14, 99.42	1090 ± 40	-25.5	A.D. 880–1020
Beta-149091***	C-40	charcoal, 2.5	Area 2, Test Unit 35	Feature 11, 99.00	1580 ± 110	-26.7	A.D. 230–660
Beta-149092	C-41	charcoal, 0.4	Area 2, Test Unit 51	Nonfeature, 99.32	100 ± 40	-28.6	A.D. 1670–1950 (modern)
Beta-149093***	C-45	charcoal, 3.6	Area 2, Test Unit 43	Feature 15, 99.04–98.99	1910 ± 70	-26.7	50 B.C.– A.D. 250
Beta-149094	F-28	charcoal, 0.1	Area 3, Test Unit 64	Feature 4, 95.98–95.55	2510 ± 40	-27.8	790–430 B.C.
Beta-154812	C-44	charred *Camassia scilloides* bulb, 0.1	Area 2, Test Unit 50	Feature 15, 98.89	1870 ± 40	-23.9	A.D. 60–240
Dates from Previous Testing Project (Abbott and Trierweiler 1995:Table D-1).							
Beta-70033	–	charcoal/soil	Test Pit 3, Level 5	Feature 2	1860 ± 80	-26.0	38 B.C.–A.D. 379
Beta-70034	–	charcoal/soil	Test Pit 1, Level 3	Feature 1	1240 ± 70	-26.2	A.D. 661–959
Beta-70035	–	charcoal	Test Pit 1, Level 6	Feature 1	920 ± 80	-25.1	A.D. 990–1263

* Samples C-17, C-28, C-30, C-35, C-39, and C-40 are *Quercus* sp. wood. Sample C-45 is an indeterminate hardwood. All other samples are unidentified wood.

** Data recovery dates were calibrated by Beta Analytic, Inc., using INTCAL98 (Stuiver et al. 1998). Testing dates were calibrated online using CALIB HTML version 4.2, University of Washington (http://depts.washington.edu/qil/calib/calib.html).

*** Standard radiometric dates; all others are done using AMS method.

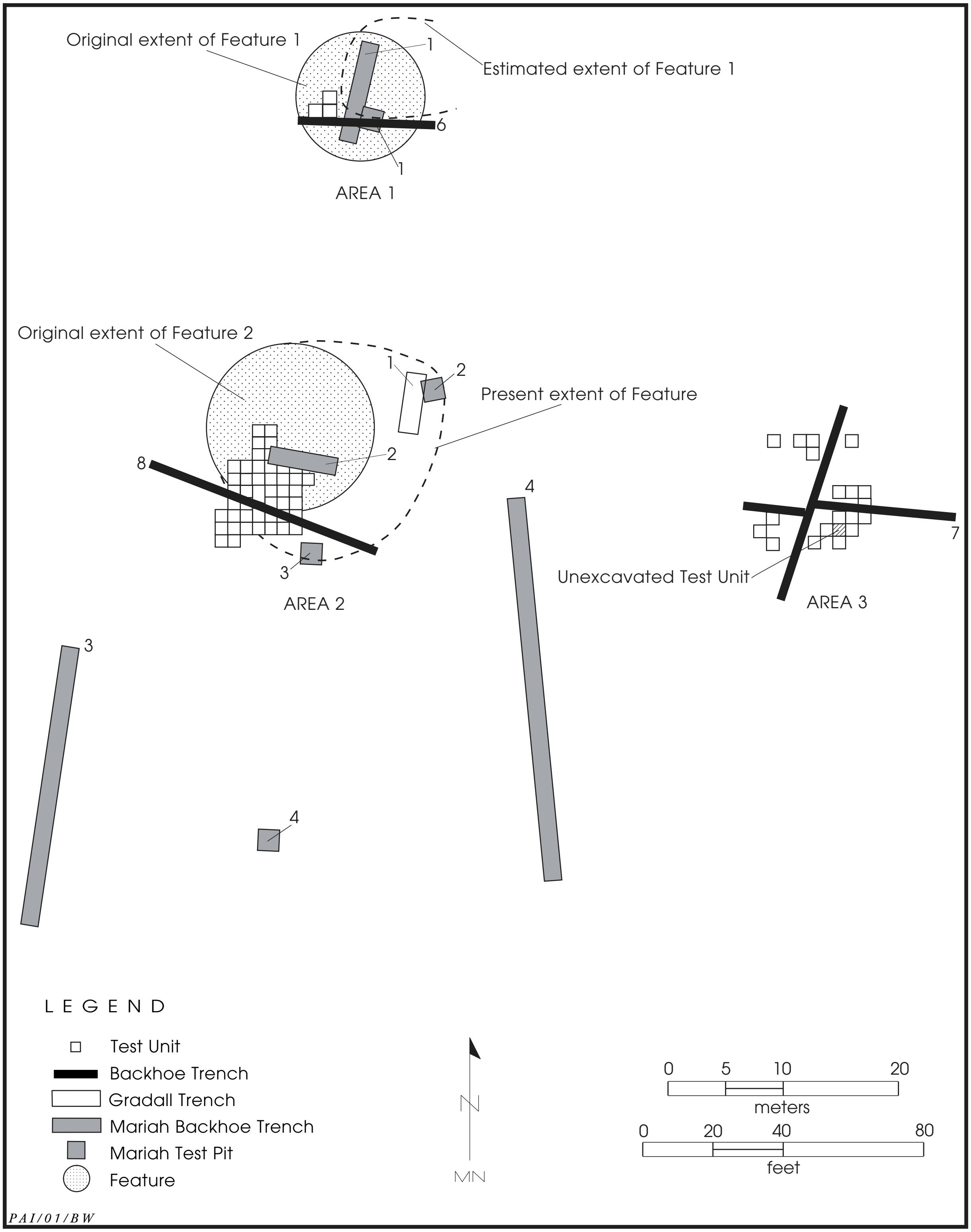


Figure 7.5. Overlay of 1993 and 2000 excavations, 41CV595. This map combines locational information from the 2000 data recovery work with locational information from the previous testing work phase (see Abbott and Trierweiler 1995:Figure 6.55).

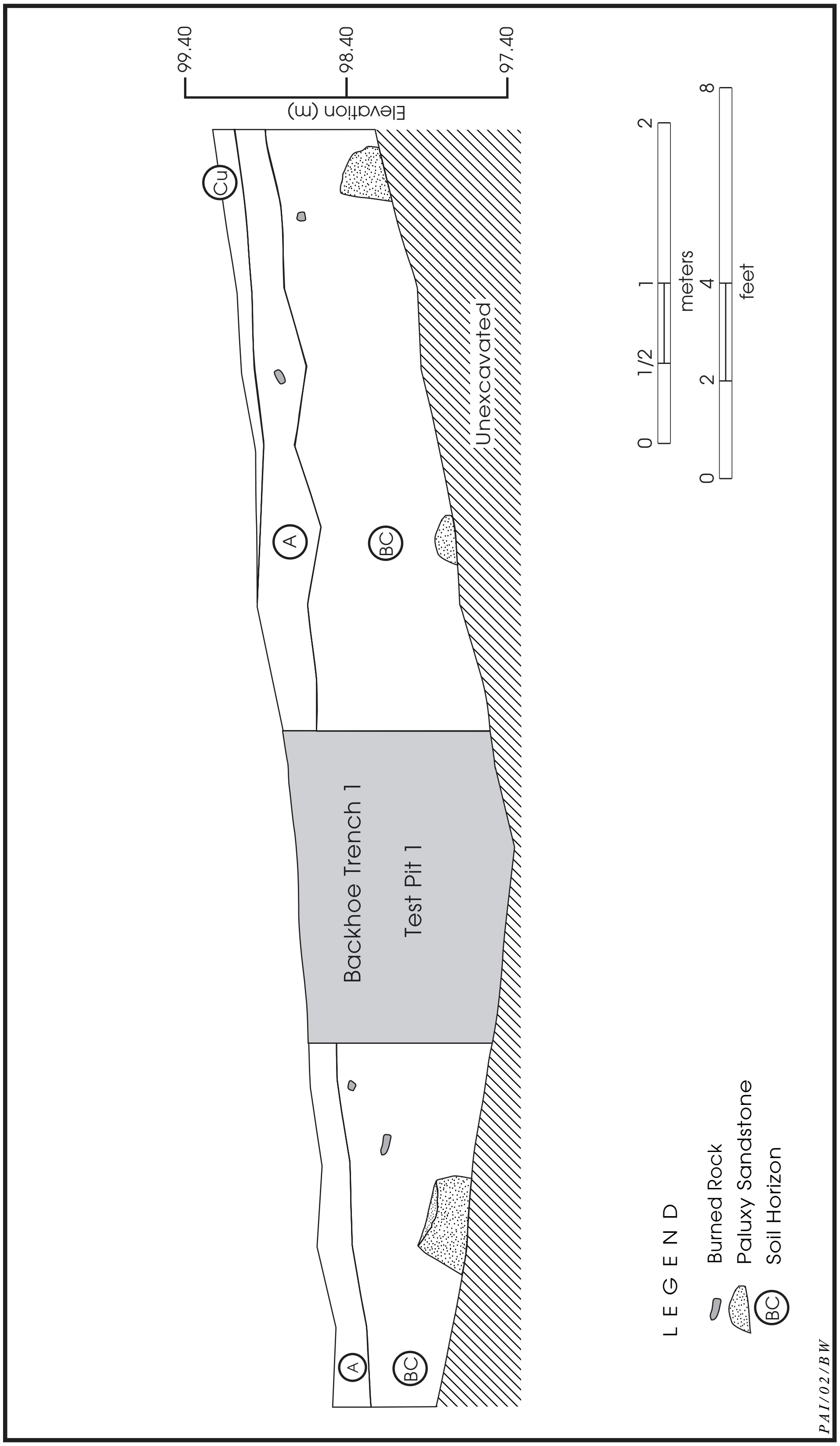


Figure 7.6. South wall profile of Backhoe Trench 6, 41CV595.

sandy mantle or Stratum I is a late Pleistocene to early Holocene deposit that displays a well-developed but truncated Bt soil. This deposit correlates to Abbott and Trierweiler's (1995a) Unit 2 or Kibler's (1999) Stratum II, which Kibler (1999:51) suggests was truncated by around 5000–4000 B.P. The deposit is typically preserved on the gentler lower slopes of Paluxy sites but is absent on the steeper upper slopes because erosion has removed it.

At 41CV595, this pedogenically altered late Pleistocene to early Holocene deposit was observed in Backhoe Trenches 7, 9, and 12 and Gradall Trench 1, and detailed profile descriptions were recorded for Backhoe Trench 7 and Gradall Trench 1. Near the western end of Backhoe Trench 7 (at Test Unit 62), the deposit is expressed as brown sandy clay loam 2Bt horizon within an A/E-2Bt-K soil profile. The 2Bt horizon (27–57 cm) is a well-structured but truncated soil overlying an indurated caliche. The burned rock features (Features 3 and 4) encountered near the middle of Backhoe Trench 7 rest on the 2Bt horizon. In Gradall Trench 1, it is expressed as a yellowish brown very fine sandy clay loam, 2Bt horizon with an A-2Bt-2Bk soil profile. The 2Bt horizon (30–76 cm) is a well-structured but truncated soil overlying pedogenically altered deposits of the Paluxy Formation.

Pedogenically modified sandy deposits of the Lower Cretaceous Paluxy Formation underlie the late Quaternary deposits on the upper slopes of the site. Deposits of the Paluxy Formation were observed in Backhoe Trench 8 and Gradall Trench 1. These deposits are slightly to highly modified and contain fragments of sandstone weathered from intact portions of the Paluxy Formation bedrock. In Backhoe Trench 8, the Paluxy Formation sediments are expressed as a slightly modified light yellowish brown loamy firm sand 2C horizon (43–82 cm) within an A-Bw-2C soil profile. In Gradall Trench 1, the Paluxy Formation deposits are expressed as a highly modified strong brown sandy clay 2Bk horizon within an A-2Bt-2Bk soil profile.

ARCHEOLOGY OF AREA 1

The data recovery sample of Area 1 consists of three test units, designated as Test Units 5–7 (see Table 7.3). The uppermost deposits were artificial fill from blading along the tank trail, and between 10 and 50 cm of disturbed sediment were removed by the backhoe before the units were excavated. In these units, cultural materials were recovered from 98.86 to 97.90 m, and 26 of the 30 excavated levels produced moderate amounts of stone artifacts and burned rocks and very sparse unmodified faunal remains (Table 7.7). Feature 6, a hearth remnant, was encountered near the base of Test Units 6 and 7 (see below). There were moderate to large pieces of burned and unburned limestone, some up to 30x30x5 cm, as well as unweathered sandstone, in the general level matrix around Feature 6. Although not recovered in situ, one large metate

Table 7.7. Summary of cultural materials, Area 1, 41CV595

	Artifacts							Faunal Remains		Burned Rocks	
Provenience	Edge-modified flakes	Cores	Tested cobble	Unmodified debitage	Metate	Hammerstone	Artifact total	Unmodified bones	Unmodified mussel shells	Count	Weight (kg)
Test Unit 5	–	1	–	42	–	–	43	1	2	36	10.20
Test Unit 6	1	–	–	32	–	–	33	2	–	71	21.00
Test Unit 7	2	2	1	35	–	1	41	–	–	54	31.00
Subtotal	3	3	1	109	0	1	117	3	2	161	62.20
Feature 6, Test Unit 6	–	–	–	3	–	–	3	2	–	18	18.00
Feature 6, Test Unit 7	–	–	–	2	–	–	2	1	–	2	2.00
Subtotal	0	0	0	5	0	0	5	3	0	20	20.00
Backhoe Trench 6	–	–	–	–	1	–	1	–	–	–	–
Total	3	3	1	114	1	1	123	6	2	181	82.20

was recovered during trenching and may have been associated with the hearth. The only other feature in Area 1 is the Feature 1 midden described by previous investigators and mentioned earlier in this chapter. 41CV595.

Cultural Features

Feature 1 is a burned rock midden described and tested by Mariah Associates archeologists in 1993 (Abbott and Trierweiler eds. 1995a:475–476). The data recovery excavations encountered the previous test excavations and did locate cultural deposits, but no concentrations of burned rocks that could be considered a burned rock midden were found. It appears that the burned rock midden deposits Mariah investigators found were primarily to the north and east of Backhoe Trench 6 and Test Units 5–7.

Crossed by Backhoe Trench 6, Feature 6 was restricted to the southern edges of Test Units 6 and 7 (Figure 7.7). Approximately 30–40 percent of an ovate cluster of burned rocks was excavated from 98.10 to 97.99 m. The excavated portion had maximum excavated dimensions of 137 cm east-west by 40 cm north-south. Because it was not visible in the opposite (south) wall of the trench, the feature is estimated to measure 137 cm east-west by 100 cm north-south. Feature 6 was composed of one to two layers of 18burned fossiliferous limestone rocks (12 kg), but only the tops of a few rocks showed discoloration from heating. Ten burned rocks (10.25 kg) also were removed during trenching. Most of the rocks consisted of tabular pieces between 5 and 25 cm in size. There were also 2 large, thin, unburned limestone slabs ranging from 22x10 cm to 40x22 cm (ca. 26 kg). One rock at the west edge of the hearth was vertical, but most lay flat or sloped at various angles. No evidence of a basin was apparent, but the feature fill was slightly darker and more mottled than the surrounding matrix and flecked with charcoal. Based on its morphology and characteristics, Feature 6 is interpreted as a remnant of a hearth or cooking pit.

Feature 6 sediment produced 5 flakes, as well as 1 unburned and 2 burned unidentifiable bone fragments. Charcoal collected at 98.07 m yielded a conventional radiocarbon age of 970 ± 40 B.P. (Beta 149084). One of two flotation samples contained oak and rose family wood. Besides being clipped by the backhoe trench, other disturbances to the feature included bioturbation and leaching of organic remains from the cultural sediment.

Cultural Materials

The artifact assemblage comprises 121 chipped stones and 2 ground or battered stone tools. The chipped stone artifacts are unmodified flakes (92.7 percent), cores and a tested cobble (3.3 percent), and other tools (4 percent) (see Table 7.7; Appendix C). The chipped stone tools are three edge-modified flakes; two are complete, and one is a distal fragment. One complete specimen is a large, cortical flake with step and hinge scars along its working edge, and the second is a cortical flake that is unifacially modified on all margins. The distal fragment appears to be a failed attempt at producing a flake tool. There are three cores, and all are complete, have multidirectional flaking, and appear to be exhausted. Cortex on two of the cores is abraded, and the third specimen shows a highly patinated weathering rind. A single tested cobble consists of a large tabular chunk of light brown chert. Its top and bottom surfaces are covered with limestone cortex, and the material is banding near its cortex. A distinctive ferrous-orange coloration is evident on the faces of former fracture planes on both sides of the cobble, which suggests that the cobble probably originates from a weathered primary chert bed. The specimen is minimally modified with no apparent flake extraction.

Of the 114 pieces of debitage, 49 (43 percent) complete specimens were recovered, as well as 16 proximal fragments (14 percent), 46 chips (40.4 percent), and 3 chunks (2.6 percent). Only 26 of the flakes exhibit any cortex, and most of the specimens (n = 88, 77.2 percent) lack cortex altogether.

Most of the 121 chipped stone artifacts (n = 117, 96.7 percent) could not be assigned to named chert types in the Fort Hood typology. Only 4 flakes (3.3 percent) are identified as being either Cowhouse White or Cowhouse Two Tone, but many of the 52 artifacts of indeterminate white or light brown chert probably represent variations of these two types.

The two ground and battered stone artifacts are a metate and a hammerstone. The metate is made of fossiliferous limestone but is fragmentary. It has an angular break across the central

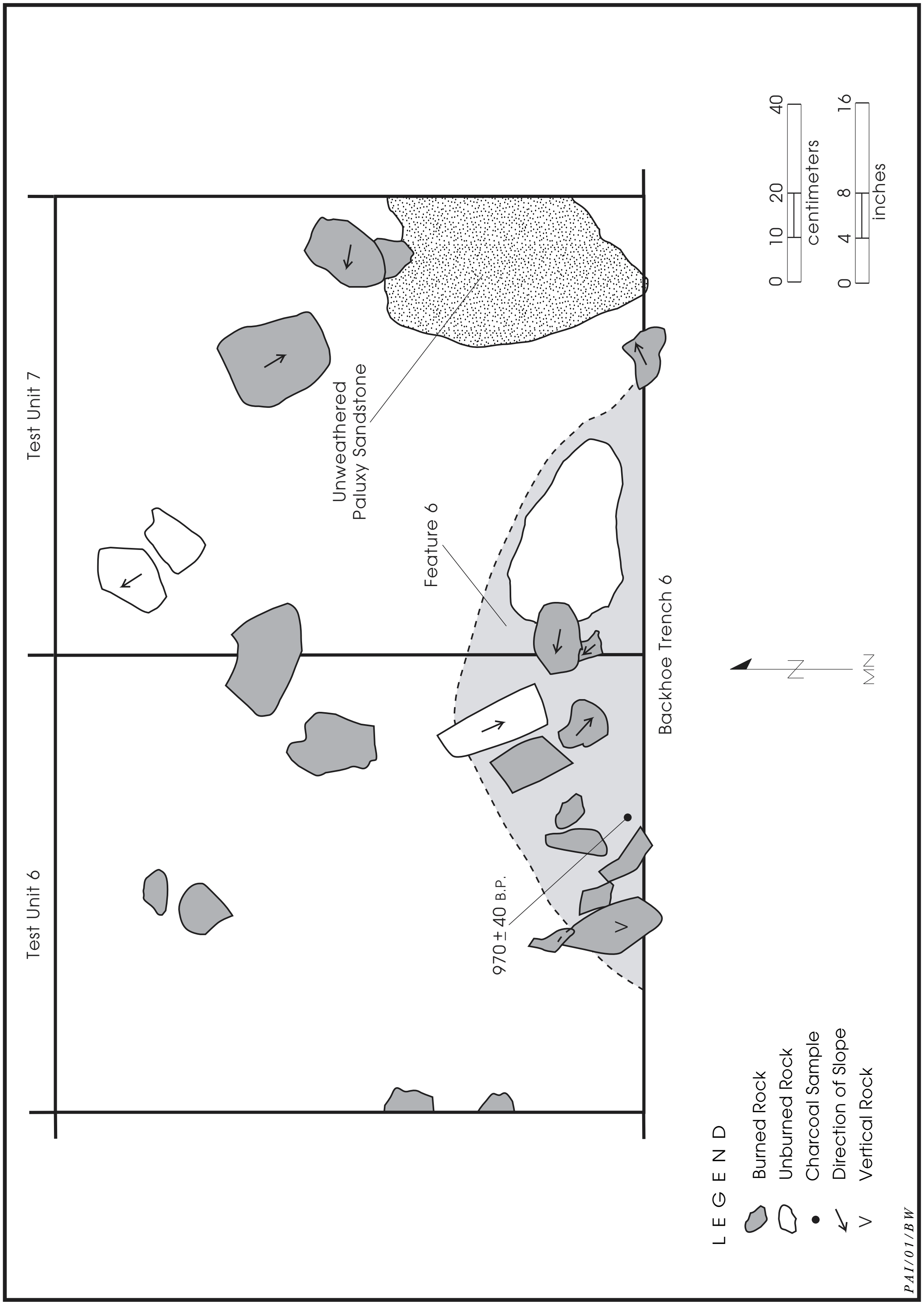


Figure 7.7. Plan view of Feature 6 from 98.10 to 97.99 m, Test Units 6 and 7, Area 1, 41CV595.

portion and represents about half of the complete metate. It has maximum dimensions of 327x251x109 mm and weighs 12.7 kg. The metate is ground only on one side. It has an ovate grinding basin (measuring 180.5x170.2 mm) that is slightly concave and shows pronounced grinding polish. A lighter polish extends to one lateral margin. It was found in the fill of Backhoe Trench 6 and could be associated with Feature 6. The hammerstone is a spherical, split chert cobble with remnant battering damage. Its maximum dimensions are 67x70x49.7 mm.

Most of the excavated levels in Area 1 contained burned rocks (188 kg), and these counts generally decreased with depth (excluding Feature 6). No significant concentrations of burned rocks were noted other than Feature 6, but a higher frequency of small, angular fragments was noted in the 40-cm-thick zone between 98.70 and 98.30 m. The bottom of this zone was 20 cm above the top of Feature 6, and these burned rocks are not associated with that feature.

The unmodified faunal remains from Area 1 are two unidentifiable mussel shell fragments, three canid- to deer-sized bones, and three indeterminate bone fragments. Three bones show evidence of burning, and one unburned specimen is spirally fractured. Finally, the limited sampling of this area produced sparse macrobotanical remains (see Appendix B).

ARCHEOLOGY OF AREA 2

Intensive hand excavations consisting of 45 contiguous test units took place in Area 2. Test Units 8 through 52 constitute the excavation block placed near the center of Backhoe Trench 8 (Figure 7.8). An approximate 1x2-m segment between Test Units 33 and 34 was not excavated because these deposits were completely removed during trenching. The ground surface sloped from west to east-southeast across the block area, but this was an artificial surface because the 1996 firebreak blading had removed an unknown amount of sediment and cultural remains from this area. Although the highest surface elevations were present near the western edge of the block (Test Units 22, 28, 39, 45, 46, and 52), these hummocks were artificial creations of the firebreak clearing activity.

Besides the removal of sediment from Area 2, 25 units were capped by obviously disturbed sediments ranging from 1 to 20 cm thick, and two other units contained modern items indicative of disturbance in the upper 20 cm (see Table 7.3). Excluding disturbed deposits that were not screened, the excavation levels in the Area 2 block ranged in elevation between 99.70 and 98.60 m, but the excavated sediments in any individual unit ranged from 15 to 85 cm thick (Figure 7.9).

Eight isolable features (see Cultural Features) were encountered in the excavation block (Figure 7.10). Seven were burned rock features (Features 8 and 10–16). Although the eighth feature (Feature 16) yielded burned rocks, it consisted primarily of large, unmodified pieces of fossiliferous limestone. The general level deposits from each test unit contained burned rocks, and at first these accumulations were designated as Feature 7. This feature designation was later abandoned because the layer of burned rocks did not characterize a distinct feature but rather a continuous cultural zone consisting of an amorphous scatter of burned rocks.

Eight flotation samples collected from the burned rock layer and various features contained eastern camas and onion bulb fragments and 17 identifiable wood types (Table 7.8). Excluding discrete features, 9 of the 45 test units produced 45.8 percent (607 kg) of the total burned rock weight (1,325 kg). These units also encompassed two substantial cooking pits (earth ovens) present in the southeast portion of the block.

Feature and nonfeature deposits in Area 2 produced 2,078 stone artifacts (Table 7.9). Although counts from unit to unit tended to vary considerably, five excavations along the southern edge of the block generated almost a third of the artifacts (619 of 1,896) from nonfeature contexts. Nine vertebrate and invertebrate remains were scattered in 3 units and 3 features. One charcoal sample collected from 99.48 m in Test Unit 16 was identified as oak wood and yielded a conventional radiocarbon age of 1,340 ± 40 B.P. (Beta 149085). An irregular soil stain was encountered from 99.40 to 99.26 m in the northeast quadrant of Test Unit 51, and several large roots bisected the unit. A flotation sample from this stain produced oak and indeterminate wood. A wood charcoal sample from this stain (at 99.32 m) yielded a conventional radiocarbon age of 100 ± 40 B.P. (Beta 149092). This date is so recent that it suggests the sample is modern.

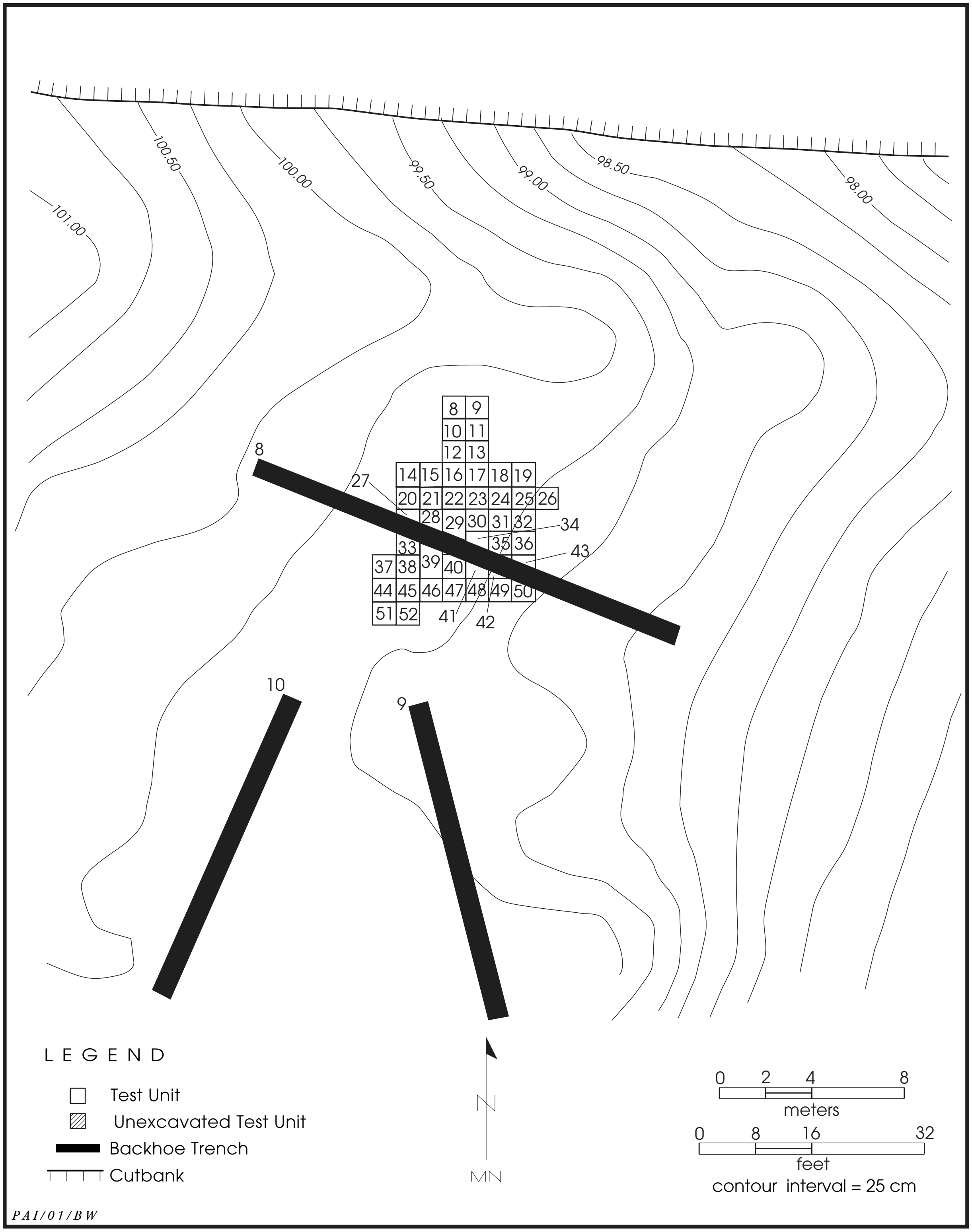


Figure 7.8. Overview of excavations in Area 2, 41CV595.

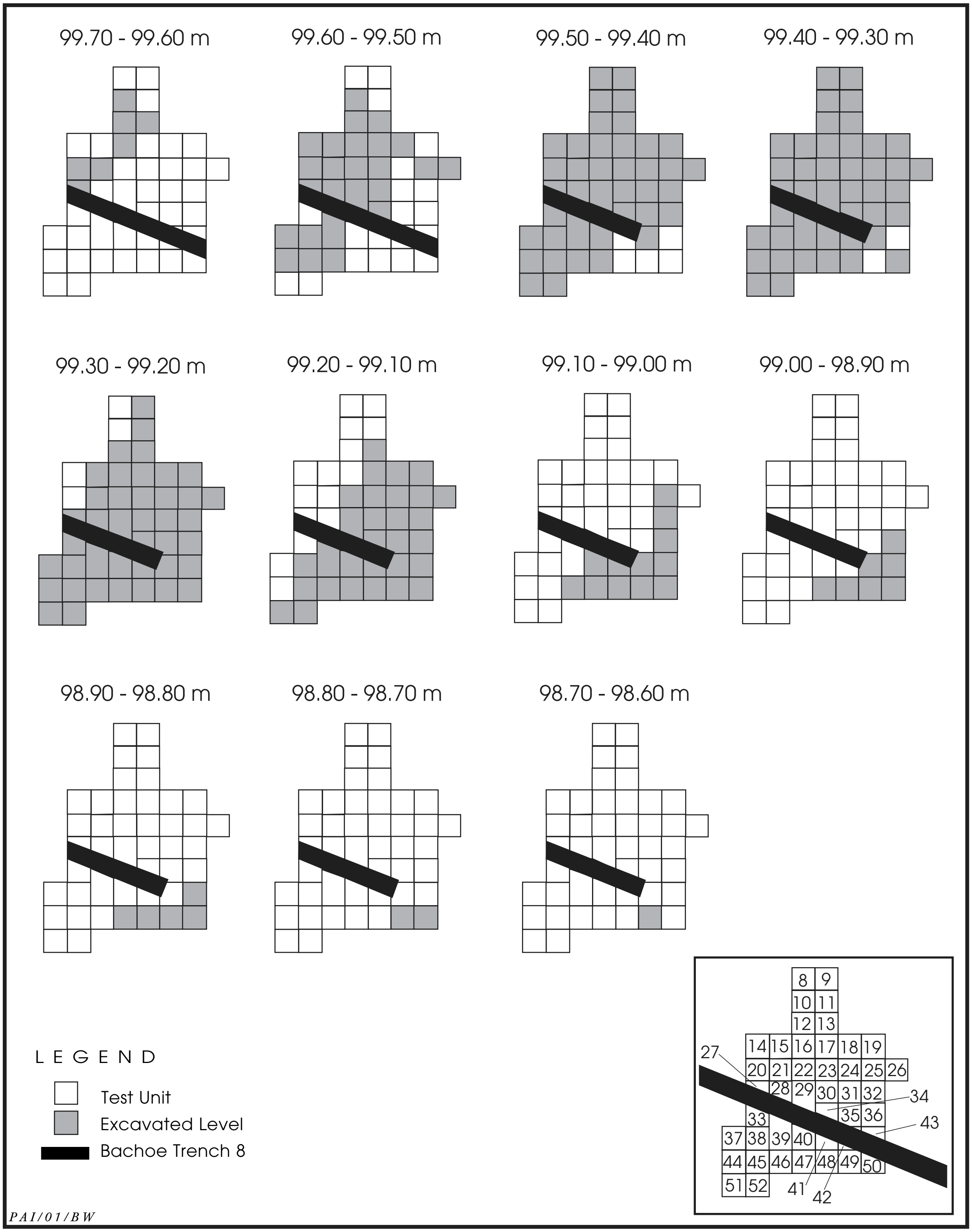


Figure 7.9. Vertical distribution of all excavation levels within Area 2, 41CV595. The distribution covers 11 layers (each 10 cm thick) from 99.7 to 98.6 m across the excavation block (includes partial levels of less than 10 cm but excludes unscreened disturbed sediments).

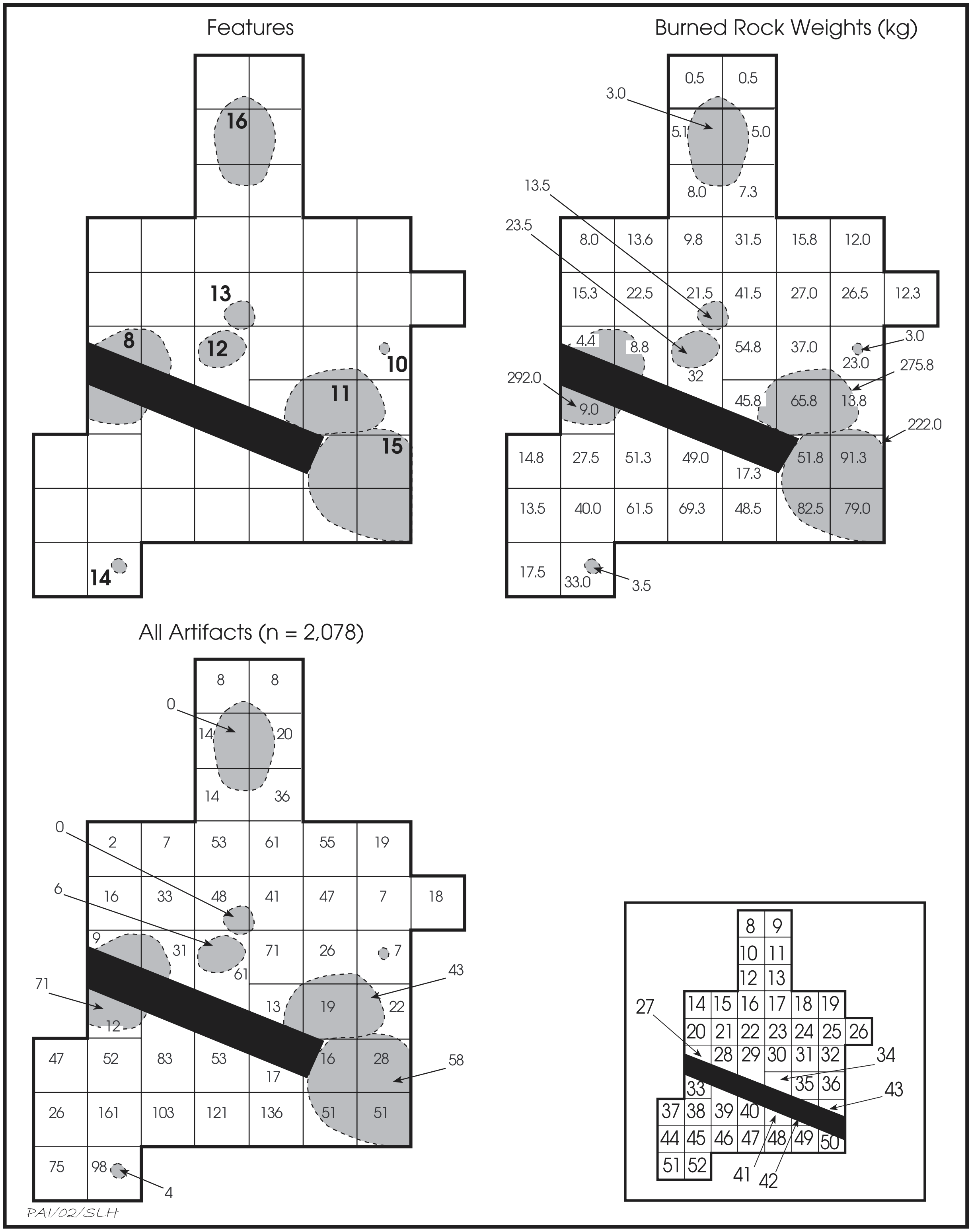


Figure 7.10. Horizontal distribution of features, burned rocks, and artifacts in Area 2, 41CV595.

Table 7.8. Charred macrobotanical remains from feature and nonfeature contexts, Area 2, 41CV595

	Acorns and Nuts		Bulbs		Woods																	
Context and Feature Type	Oak	Pecan	Eastern camas	Wild onion	Ash	Boxelder	Dogwood	Elm	Hackberry	Hickory	Maple	Mulberry	Oak	Pecan	Persimmon	Rose family	Soapberry	Sumac	Sycamore	Walnut	Willow family	Indeterminate
Feature 8, earth oven	x	–	–	–	x	–	–	x	–	x	–	–	x	–	–	–	–	x	x	x	–	–
Outside Feature 8	–	–	–	–	x	–	–	–	x	–	–	–	x	–	–	–	–	–	–	–	–	x
Feature 11, earth oven	x	x	–	–	–	–	–	–	x	–	–	x	x	x	–	–	–	–	–	x	x	–
Below Feature 11	–	–	–	–	–	–	–	–	–	–	–	–	x	–	x	–	–	–	–	–	–	x
Feature 12, hearth	–	–	–	–	x	–	–	–	–	–	x	–	x	–	–	–	–	–	–	–	–	–
Feature 14, hearth	–	–	–	–	–	–	–	x	–	–	–	–	x	–	–	–	–	–	–	–	–	x
Feature 15, earth oven	–	–	x	–	–	–	x	x	–	–	–	x	x	x	–	x	x	–	–	–	–	x
Below Feature 15	–	–	x	–	–	–	–	–	x	–	–	–	x	–	–	–	–	–	–	–	–	x
Feature 7, burned rock layer	–	–	x	x	x	x	x	x	x	–	–	–	x	–	–	x	x	x	–	x	–	–
Soil stain (modern date)	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	x

Table 7.9. Summary of provenience data for all cultural materials, Area 2, 41CV595

		Artifacts																	Burned Rocks		Unburned Rocks	
Test Unit	Feature	Arrow point preform	Dart points	Early- to middle-stage bifaces	Late-stage to finished bifaces	Miscellaneous biface	End scraper	Side scraper	Miscellaneous unifaces	Spoke shave	Burins	Core tool	Edge-modified flakes	Cores	Unmodified debitage	Metate	Other ground stones	Artifact total	Count	Weight (kg)	Count	Weight (kg)
27, 28, & 33	8	–	–	1	–	–	–	–	–	–	–	–	2	–	68	–	–	71	417	292.0	–	–
32	10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	10	3.0	–	–
31 & 34 to 36	11	–	–	–	–	–	–	–	–	–	–	–	1	–	42	–	–	43	165	275.8	–	–
29	12	–	–	–	–	–	–	–	–	–	–	–	–	–	6	–	–	6	62	23.5	–	–
22	13	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	69	13.5	–	–
52	14	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	4	31	3.5	–	–
42, 43, 49, & 50	15	–	–	–	–	–	–	–	–	–	–	–	1	–	57	–	–	58	156	222.0	–	–
8 to 13	16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	7	3.0	23	71.5
Feature subtotal		0	0	1	0	0	0	0	0	0	0	0	4	0	177	0	0	182	917	836.3	23	71.5
8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8	–	–	8	4	0.5	–	–
9	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8	–	–	8	3	0.5	–	–
10	–	–	–	–	1	–	–	–	–	–	–	–	–	–	13	–	–	14	15	5.1	–	–
11	–	–	–	–	–	–	–	–	–	–	–	–	–	–	20	–	–	20	17	5.0	–	–
12	–	–	–	1	–	–	–	–	–	–	–	–	–	–	13	–	–	14	54	8.0	–	–
13	–	–	–	1	–	–	–	–	1	1	–	–	3	–	30	–	–	36	59	7.3	–	–
14	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	2	35	8.0	–	–
15	–	–	–	1	–	–	–	–	–	–	–	–	–	–	6	–	–	7	56	13.6	–	–
16	–	–	1	–	–	–	–	–	–	–	–	–	1	1	50	–	–	53	69	9.8	–	–
17	–	–	1	–	–	–	–	–	–	–	–	–	1	–	59	–	–	61	109	31.5	–	–
18	–	–	–	–	–	–	–	–	–	–	–	–	–	–	55	–	–	55	115	15.8	–	–
19	–	–	–	–	–	–	–	–	–	–	–	–	–	–	19	–	–	19	58	12.0	–	–

Table 7.9, continued

		Artifacts																	Burned Rocks		Unburned Rocks	
Test Unit	Feature	Arrow point preform	Dart points	Early- to middle-stage bifaces	Late-stage to finished bifaces	Miscellaneous biface	End scraper	Side scraper	Miscellaneous unifaces	Spoke shave	Burins	Core tool	Edge-modified flakes	Cores	Unmodified debitage	Metate	Other ground stones	Artifact total	Count	Weight (kg)	Count	Weight (kg)
20	–	–	–	–	1	–	–	–	–	–	1	–	–	–	14	–	–	16	64	15.3	–	–
21	–	–	–	–	–	–	–	–	–	–	–	–	1	–	32	–	–	33	97	22.5	–	–
22	–	–	–	–	–	–	–	–	–	–	–	–	–	–	48	–	–	48	99	21.5	–	–
23	–	–	–	–	–	–	–	–	–	–	–	–	–	–	41	–	–	41	189	41.5	–	–
24	–	–	–	–	–	–	–	–	–	–	1	–	–	–	46	–	–	47	106	27.0	–	–
25	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	1	–	7	110	26.5	–	–
26	–	–	–	–	–	–	–	–	–	–	–	–	–	–	18	–	–	18	61	12.3	–	–
27	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9	–	–	9	22	4.4	–	–
28	–	–	–	–	–	–	–		–	–	–	–	1	–	30	–	–	31	82	8.8	–	–
29	–	–	3	–	–	–	–	–	–	–	–	–	2	–	56	–	–	61	173	32.0	–	–
30	–	–	–	2	–	–	–	–	–	–	–	–	–	1	68	–	–	71	416	54.8	–	–
31	–	–	1	–	–	–	–	–	–	–	–	–	–	–	25	–	–	26	234	37.0	–	–
31 & 35	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	4	–	–	–	–
32	–	1	–	–	–	–	–	–	–	–	–	–	–	–	6	–	–	7	212	23.0	–	–
33	–	–	–	–	–	–	–	–	–	–	–	–	1	–	11	–	–	12	26	9.0	–	–
34	–	–	–	–	–	–	–	–	–	–	–	–	1	–	12	–	–	13	290	45.8	–	–
35	–	–	–	–	–	–	–	–	–	–	–	–	–	–	15	–	–	15	602	65.8	–	–
36	–	–	–	–	1	–	–	–	–	–	–	–	1	1	19	–	–	22	104	13.8	–	–
36 & 43	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	4	–	–	–	–
37	–	–	–	1	1	–	–	–	–	–	–	–	–	–	45	–	–	47	80	14.8	–	–
38	–	–	–	–	–	–	–	–	1	–	–	1	–	–	50	–	–	52	76	27.5	–	–
39	–	–	2	–	–	–	–	–	–	–	–	–	–	1	80	–	–	83	269	51.3	–	–

Table 7.9, continued

Test Unit	Feature	Artifacts: Arrow point preform	Dart points	Early- to middle-stage bifaces	Late-stage to finished bifaces	Miscellaneous biface	End scraper	Side scraper	Miscellaneous unifaces	Spoke shave	Burins	Core tool	Edge-modified flakes	Cores	Unmodified debitage	Metate	Other ground stones	Artifact total	Burned Rocks: Count	Weight (kg)	Unburned Rocks: Count	Weight (kg)
40	–	–	3	–	1	1	–	–	–	–	–	–	–	–	48	–	–	53	332	49.0	–	–
41	–	–	–	–	–	–	–	–	–	–	–	–	–	–	17	–	–	17	71	17.3	–	–
42	–	–	–	–	–	–	–	–	–	–	–	–	–	–	12	–	–	12	138	51.8	–	–
42 & 43	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	4	–	–	–	–
43	–	–	1	–	–	–	–	–	–	–	–	–	–	2	21	–	–	24	251	91.3	–	–
44	–	–	–	–	–	–	–	–	1	–	–	–	–	1	24	–	–	26	67	13.5	–	–
45	–	–	1	–	–	–	–	–	–	–	–	–	1	1	158	–	–	161	199	40.0	–	–
46	–	–	–	1	–	–	1	–	–	–	–	–	1	1	99	–	–	103	382	61.5	–	–
47	–	–	–	–	–	–	–	–	–	–	1	–	1	1	118	–	–	121	185	69.3	–	–
48	–	–	1	–	–	–	–	–	–	–	–	–	1	–	134	–	–	136	158	48.5	–	–
49	–	–	–	2	1	–	–	1	–	–	–	–	–	–	46	–	1	51	219	82.5	–	–
50	–	–	1	–	–	–	–	–	–	–	–	–	–	–	50	–	–	51	259	79.0	–	–
51	–	–	–	–	1	–	–	–	–	–	–	–	–	1	72	–	1	75	39	17.5	–	–
52	–	–	–	–	–	–	–	–	–	–	–	–	–	1	97	–	–	98	108	33.0	–	–
Nonfeature subtotal		1	15	9	7	1	1	1	3	1	3	1	16	12	1,822	1	2	1,896	6,314	1,325.9	0	0.0
Total		1	15	10	7	1	1	1	3	1	3	1	20	12	1,999	1	2	2,078	7,231	2,162.2	23	71.5

Note: Features exclude Feature 7; this designation was used in the field but later dropped.

Cultural Features

Previous investigations in Area 2 revealed a large burned rock feature (Feature 2), and subsequent data recovery investigations identified and documented nine more features (Features 7, 8, and 10–16). Feature 2 is a burned rock midden Mariah Associates archeologists documented in 1993 (Abbott and Trierweiler, eds. 1995a:477–478). The ovate feature was described as being 22 m long by 15 m wide and ca. 70 cm thick, but firebreak clearing destroyed most of it in 1996. The feature was no longer evident on the surface in 2000, but the Area 2 block excavation was placed in the general vicinity of Feature 2 (see Figure 7.5). The work revealed that the upper portion (perhaps 30 to 50 cm) of Feature 2 had been bladed away but that some of the features encountered in the Area 2 excavation block might be related to the Feature 2 midden.

Aside from the general rock scatter, six features were present within a 6 m east-west by 4.5 m north-south section of the excavation block in Area 2, and two outlying features occurred near the north-central and southwest block margins. Backhoe Trench 8 crossed Feature 8, a cooking pit, which was visible in the north and south trench walls. The excavated portion of Feature 8 was in Test Units 27, 28, and 33 (Figure 7.11). Present from 99.55 to 99.11 m, the feature had maximum dimensions of 175 cm northwest-southeast by 164 cm northeast-southwest and consisted of three to four rock layers. A total of 417 burned pieces of fossiliferous limestone (292 kg) were found in the feature fill, with almost three-fourths of the highly fractured, angular rocks ranging from 5 to 15 cm in size. The rest consisted primarily of smaller angular fragments, although there were also larger tabular pieces present. Many of the rocks were broken in place, but it is not known whether they simply fractured when they were heated or if the weight of heavy bulldozers used during the firebreak blading caused further fracturing. Approximately 75 percent of the matrix consisted of charcoal-stained sediment, with darker sediments in the central area and lighter deposits closer to the perimeter of the hearth. The base of the feature undulated and showed evidence of animal burrowing and later leaching of organic matter. One biface, 2 edge-modified flakes, 59 pieces of debitage, and 2 unidentifiable bone fragments were recovered from the feature matrix. Oak wood charcoal collected at 99.34 m yielded a conventional radiocarbon age of 1280 ± 40 B.P. (Beta 149087). Flotation samples contained seven wood types along with oak acorn fragments (see Table 7.8). Ash, hackberry, oak, and indeterminate woods also were found in one flotation sample collected among a few burned rocks by the northwest edge of Feature 8. Organic residues were extracted from three burned rocks and analyzed (see Appendix C).

Features 10, 11, and 15 were found in close proximity to each other (Figure 7.12). Feature 10 is a burned rock concentration that was present from 99.11 to 99.07 m in the central portion of Test Unit 32 and about 40 cm northeast of Feature 11 (Figure 7.13). This single layer of 10 horizontally laid burned rocks (3 kg) had maximum dimensions of 40 cm east-west by 30 cm north-south. The angular pieces of fossiliferous limestone ranged from 6 to 12 cm in size. There were no artifacts or charred macrobotanical remains in the feature matrix, but a small cluster of *Rabdotus* snail shells occurred along the west edge of the feature, and several were scattered between and beneath the burned rocks. No charcoal, stained sediment, or disturbances were apparent. Organic residues were extracted from one burned rock and analyzed (see Appendix C). Feature 10 may represent a dump–perhaps debris from one of the cooking features or stone boiling activity.

Feature 11 is a well-defined cooking pit or earth oven (see Figure 7.13). It was contained primarily in Test Unit 35 but extended into Test Units 31, 34, and 36. The southwest edge of the feature was removed during trenching, and its southeast margin abutted Feature 15. The boundary between the two was somewhat difficult to discern, but Feature 11 was clearly the older of the two and had been disturbed by construction of Feature 15. Feature 11 was encountered from 99.31 to 98.93 m and consisted of the well-prepared pit lined with up to three layers of burned rocks. Imbrication was most apparent from the perimeter of the feature inward approximately 40 cm toward the center of the pit. Here, large tabular pieces and slabs either sloped severely or were vertical. Feature 11 was composed of 165 pieces of fossiliferous limestone that weighed 275.75 kg. Almost 80 percent of these rocks (n = 131) were 5 to 25 cm in size. Most were thin, tabular rocks and slabs that

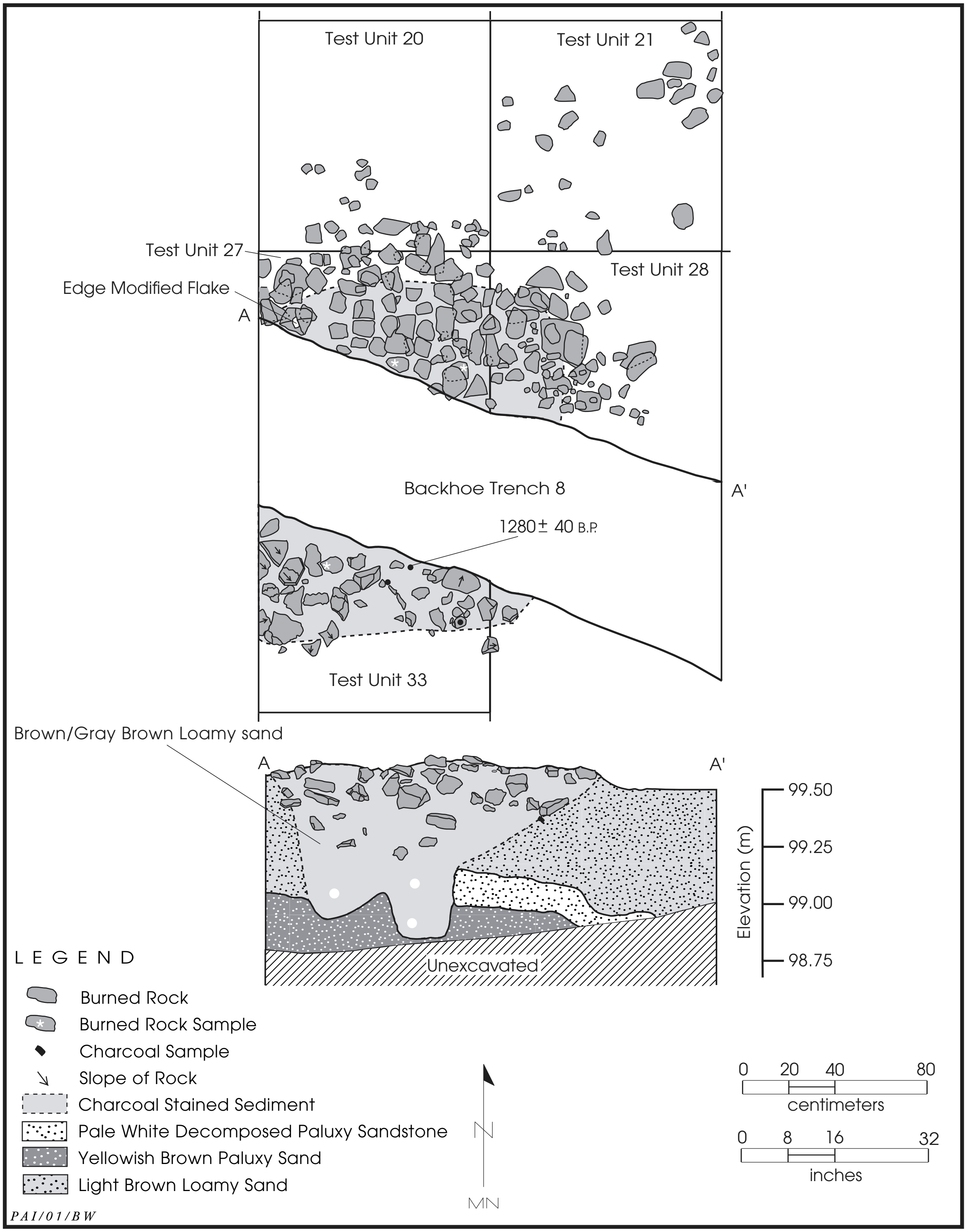


Figure 7.11. Plan and profile of Feature 8 in Area 2, 41CV595. Plan view of burned rocks exposed in Test Units 27, 28, and 33 from 99.55 to 99.11 m. Profile is the north wall of Backhoe Trench 8.

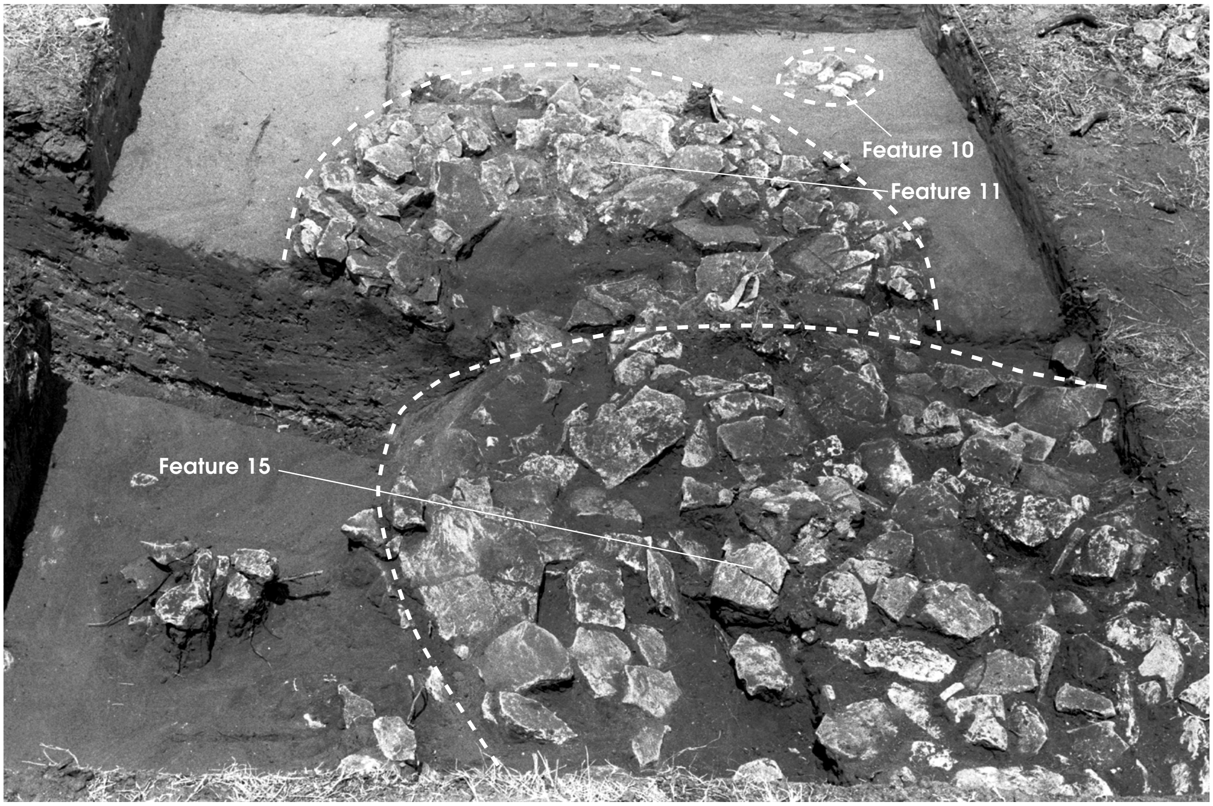


Figure 7.12. Photograph of Features 10, 11, and 15 in Area 2, 41CV595.

fractured on removal or were broken in place. The largest slabs measured 38x25x7 cm, and there were no small (less than 5 cm), angular fragments. All of the fine-grained sediment in and around the rocks was gray organic-rich fill, but there was a semi-circular, darker charcoal stain (52x32x2 cm) near the south-central edge of the pit. There were fewer rocks in this darker stain, and it probably represents the center of the cooking pit. Maximum excavated feature dimensions were 200 cm east-west by 136 cm north-south, but the full extent of the pit was estimated to be 200x160 cm. Besides having been clipped by the backhoe trench, the only other disturbance to Feature 11 appears to be minimal leaching of organic material at the bottom of the feature. Two unidentifiable bone fragments, 1 edge-modified flake, and 43 pieces of debitage were recovered from the feature matrix. Three charcoal samples collected between 99.16 and 99.00 m yielded conventional radiocarbon ages of 2140 ± 40 B.P. (Beta 149089), 2050 ± 40 B.P. (Beta 149088), and 1580 ± 110 B.P. (Beta 149091). Six wood types were identified in the flotation samples, as well as oak acorn and pecan nut fragments (see Table 7.8). One flotation sample consisting of the mottled sediments below the Feature 11 rocks produced oak, persimmon, and an indeterminate wood. Organic residues were extracted from three burned rocks and analyzed (see Appendix C).

Adjoining the southeast edge of Feature 11 was a second, larger cooking pit or earth oven. Designated as Feature 15, it was found in Test Units 42, 43, 49, and 50 and occurred from 99.18 to 98.89 m (Figure 7.14). The construction of Feature 15 was similar to Feature 11, except that the burned rocks defining the perimeter were not as densely packed, although most were at a steeper angle or vertical. Feature 15 consisted of two to three layers of burned fossiliferous limestone rocks (n = 156, 222 kg). About 64 percent (n = 99) of the rocks were tabular pieces and slabs 5 to 25 cm in size and typically less than 7 cm thick. Eleven large slabs ranging between 25 and 45 cm accounted for almost 30 percent (66.5 kg) of the total rock weight. Maximum excavated dimensions were 210 cm north-south by 206 cm east-west, but the pit was estimated to extend another 20 cm beyond the excavation block to the south and to the east. Artifacts in the feature matrix consisted of 57 flakes and

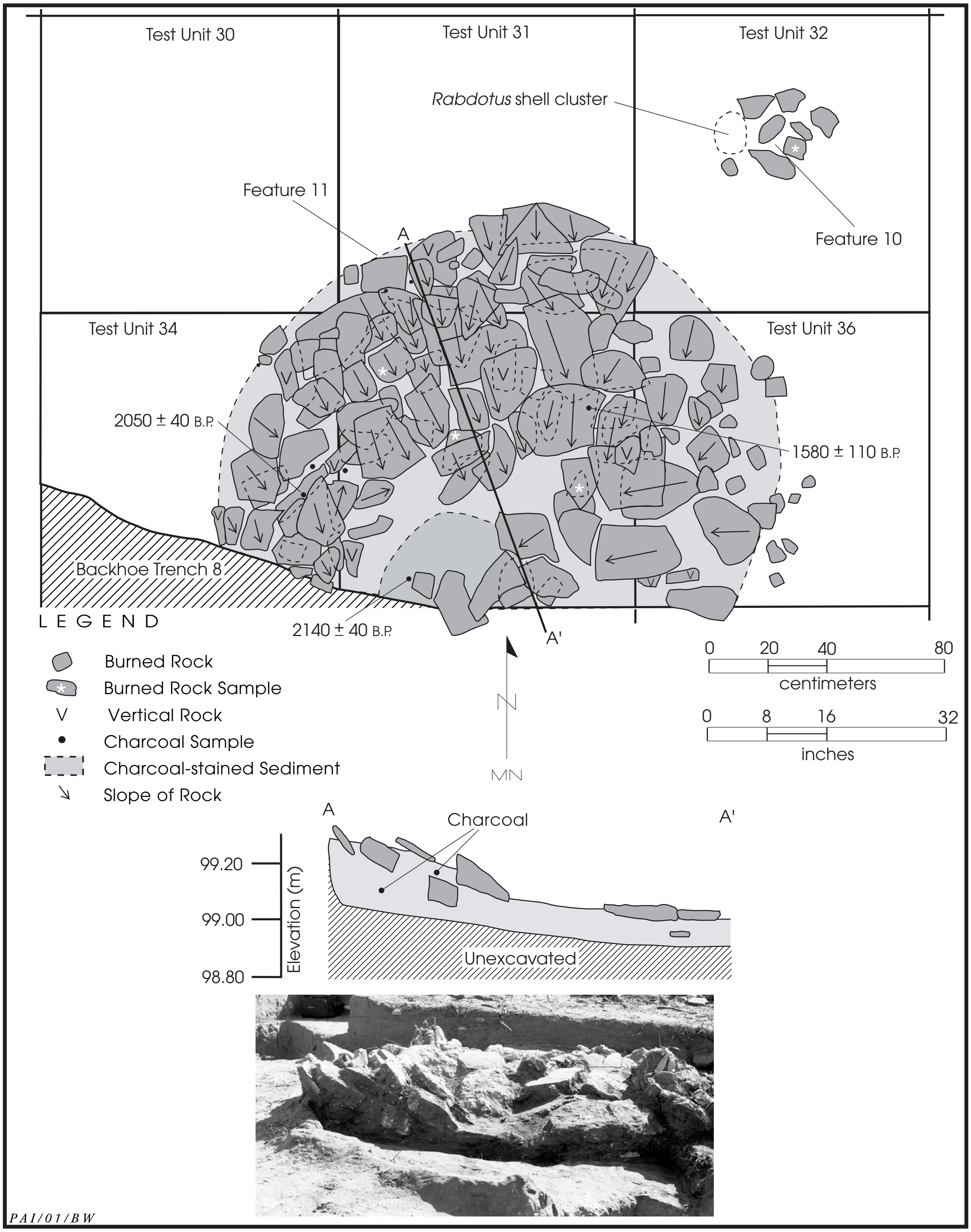


Figure 7.13. Plan of Features 10 and 11 and profile of Feature 11 in Area 2, 41CV595. Plan view shows Feature 10 exposed in Test Unit 32 at 99.10 m and Feature 11 in Test Units 31, 34, 35, and 36 from 99.31 to 98.93 m. Profile and photograph are a cross section of Feature 11 in Test Units 31 and 35.

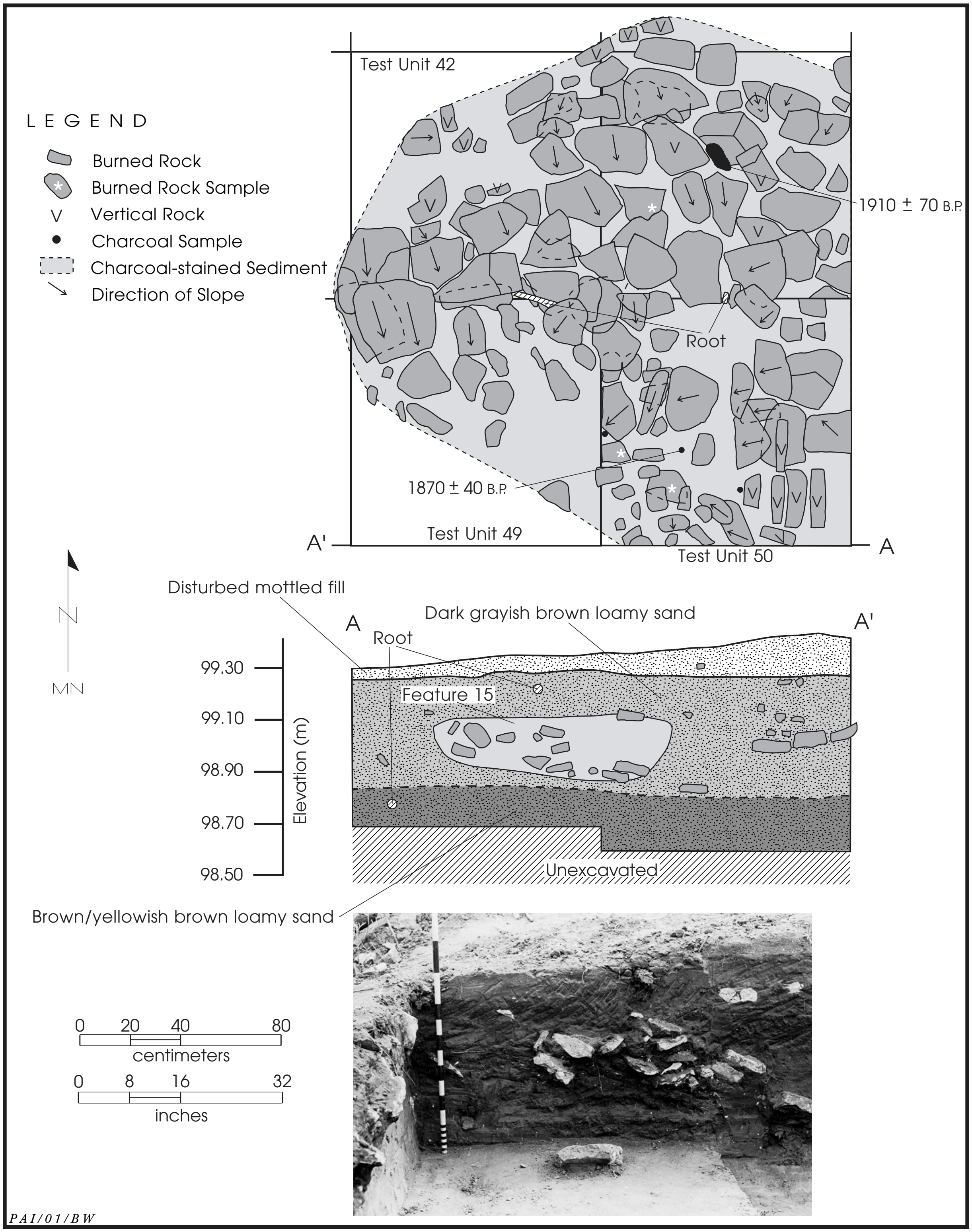


Figure 7.14. Plan and profile of Feature 15 in Area 2, 41CV595. Plan view shows burned rocks exposed in Test Units 42, 43, 49, and 50 from 99.18 to 98.89 m. Profile and photograph show the south wall of Test Units 49 and 50.

1 edge-modified flake. Flotation of the gray organic-rich feature ssediments yielded eight wood taxa and eastern camas (wild hyacinth) bulb fragments (see Table 7.8). Two samples collected between 99.04 and 98.89 m were submitted for radiocarbon assay. Indeterminate diffuse porous hardwood charcoal yielded a conventional radiocarbon age of 1910 ± 70 B.P. (Beta 149093), and charred fragments of eastern camas bulbs yielded a conventional radiocarbon age of 1870 ± 40 B.P. (Beta 154812). Leaching of organic sediments and minimal root activity were the only disturbances observed in Feature 15. Hackberry, oak, and indeterminate woods, as well as one eastern camas bulb fragment, were identified in a flotation sample collected from sediment directly beneath the Feature 15 rocks. Fragments extracted from three of the burned rocks in Feature 15 were analyzed for organic residues (see Appendix C).

Feature 12, which is interpreted as a hearth, adjoins Feature 13, a burned rock concentration (Figure 7.15). Feature 12 was contained in Test Unit 29 from 99.47 to 99.39 m. This ovate hearth had maximum dimensions of 98 cm east-west by 92 cm north-south and consisted of one burned rock layer resting relatively flat. It comprised 62 angular and tabular pieces of fossiliferous limestone weighing 23.5 kg. All of the rocks were no larger than 15 cm in maximum dimension. Rootlets were noted in the feature fill, but the hearth appeared to be virtually undisturbed. Unlike Features 11 and 15, this hearth contained no organic-stained soil. The feature fill produced six flakes, and a flotation sample contained ash, maple, and oak wood. A charcoal sample collected at 99.47 m yielded a conventional radiocarbon age of 1310 ± 40 B.P. (Beta 149086).

Feature 13 is a burned rock concentration that was confined primarily to the southeast quadrant of Test Unit 22 (see Figure 7.15). Encountered from 99.50 to 99.40 m, the feature had maximum dimensions of 63 cm east-west by 46 cm north-south. It was composed of a single layer of 69 horizontally laid burned rocks that weighed 13.5 kg.

Approximately equal numbers of fist-sized and smaller angular fragments and tabular pieces of fossiliferous limestone made up the feature. No staining was apparent among the burned rocks, and there were no artifacts or charred macrobotanical remains in the feature sediment. The lack of organic staining and jumbled appearance of the rocks suggest that Feature 13 may represent a dump of burned rocks, perhaps from clean out of a nearby hearth (e.g., Feature 12) or earth oven (e.g., Features 8 or 11).

Situated in the southwest corner of the excavation block 2.5 m south of Feature 8, Feature 14 is interpreted as a basin-shaped hearth. Feature 14 was encountered from 99.44 to 99.31 m near the center of Test Unit 52 (Figure 7.16). There were burned rocks present across much of the unit, and the feature was originally identified by a charcoal stain measuring 37 cm east-west by 34 cm north-south. No burned rocks were visible in this area when the stain was first recognized, but removing the sediment exposed highly fragmented pieces of burned fossiliferous limestone within a shallow pit.

Three tabular burned rocks were lying flat on the bottom of the feature. The feature contained 77 burned rocks (20 kg) that formed two layers, and most of the rocks (n = 54) were angular pieces less than 5 cm in size. The feature matrix contained four flakes, along with elm, oak, and indeterminate woods. A charcoal sample collected at 99.44 m yielded a conventional radiocarbon age of 1090 ± 40 B.P. (Beta 149090). No evidence of disturbance was noted.

Feature 16 was found in the six units (Test Units 8 through 13) forming the north end of the excavation block in Area 2. Occurring from 99.40 to 99.25 m, this large feature was a scatter of burned and unburned pieces of fossiliferous limestone without any hint of organic staining associated (Figure 7.17). The maximum dimensions of Feature 16 were 212 cm north-south by 184 cm east-west, but many of the unburned rocks formed a roughly circular outline, approximately 160x140 cm, in the southern portion of the feature. In between these rocks was a circular area, about 70 cm in diameter, where no rocks were found. The burned rocks were found in two clusters at the southwest and northeast edges of the concentration of unburned rocks.

The Feature 16 rocks include seven angular and blocky burned rocks (3 kg) that were all less than 15 cm in size, but the 23 unburned rocks (71.5 kg) are significantly larger. They are rounded and irregular cobbles that are complete (unbroken) and range in size from 15 to 35 cm. No artifacts or flotation samples were recovered

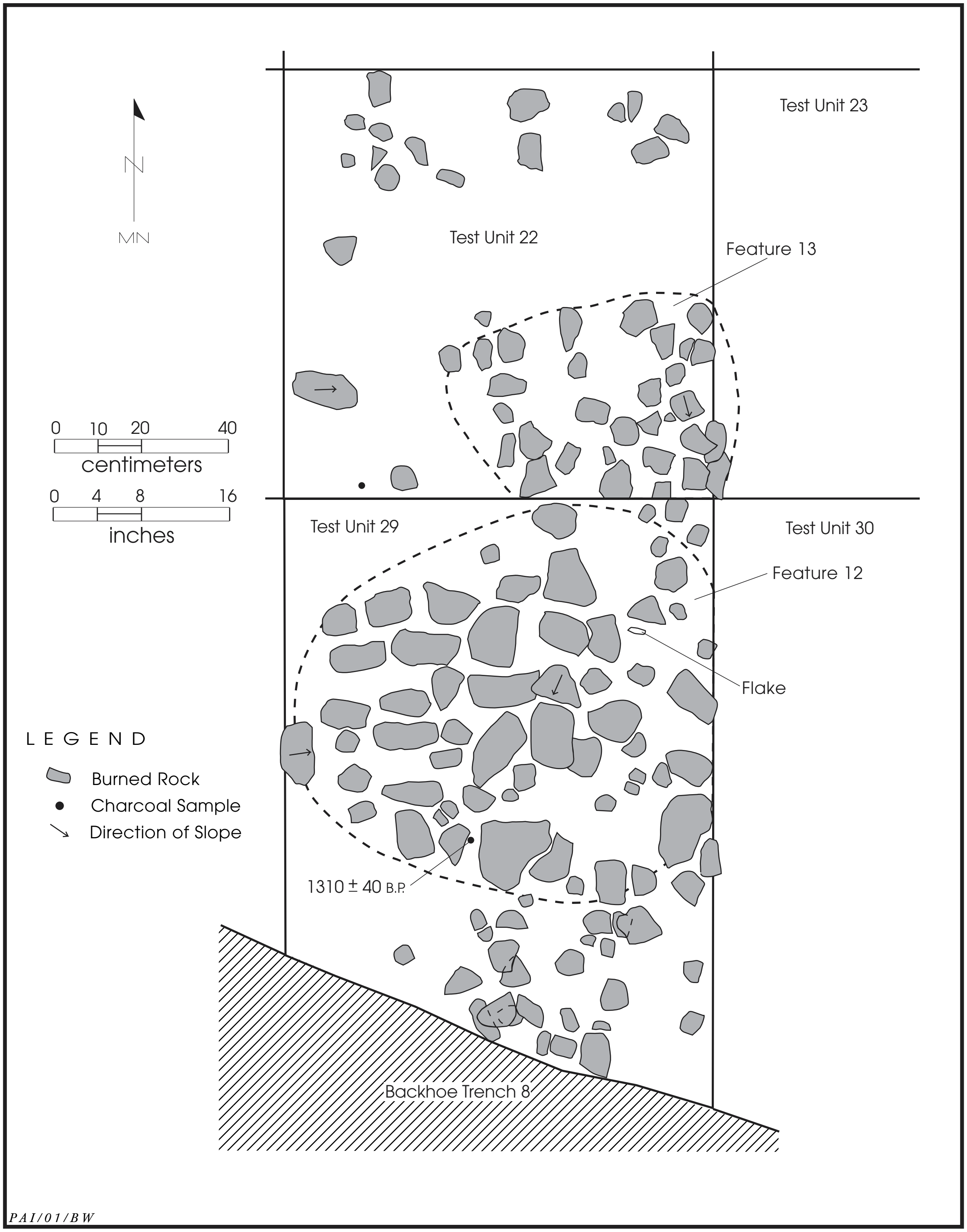


Figure 7.15. Plan of Feature 12 in Test Unit 29 from 99.47 to 99.39 m and Feature 13 in Test Unit 22 from 99.50 to 99.40 m, Area 2, 41CV595.

Figure 7.16. Plan of Feature 14 exposed in Test Unit 52 from 99.44 to 99.31 m, Area 2, 41CV595.

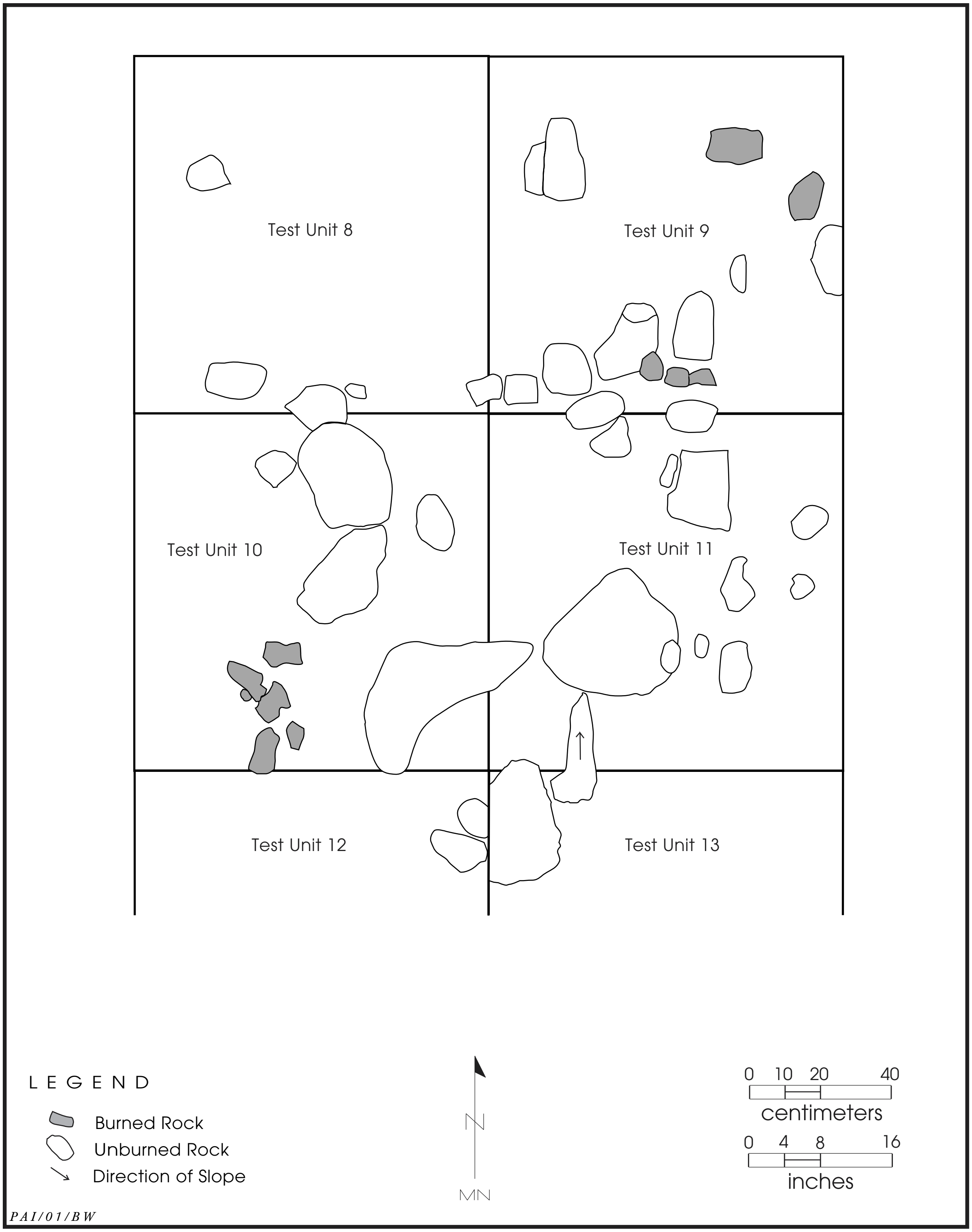


Figure 7.17. Plan of Feature 16 exposed in Test Units 8–13 from 99.40 to 99.25 m, Area 2, 41CV595.

from the unstained feature matrix, and no evidence of disturbance was apparent.

When the feature was fully exposed, the rocks in the southern portion of the feature (i.e., those in Test Units 10–13) were removed and weighed, and the excavation continued below the level of the rocks. The rocks that make up the northern extent of the features—those in Test Units 8 and 9—were exposed, removed and weighed, and then returned to their original positions and left in place when the excavations were backfilled.

The unburned and burned rocks in Feature 16 clearly represent manuports because these materials do not occur naturally in the sandy deposits, but what they represent is unclear. The circular pattern of large unburned rocks caught the excavators' attention, and considerable care was taken to discover whether the rocks were associated with a structure—perhaps large weights around the edge of a small hut. The area was searched carefully for unusual sediment stains or artifact patterns that might be evidence of a house, but no such evidence was found. It should be noted, however, that it is unlikely that any subtle forms of evidence (e.g., small postholes or floor surfaces) would be preserved in the sandy Paluxy sediments.

Other researchers have noted the problems of identifying subtle architectural features in sandy soils (e.g., Carmichael 1985:146). Sandy soils are notorious for being extensively bioturbated, and evidence of bioturbation (including old rodent burrows) may be almost undetectable in homogenous sandy matrix (Waters 1992: 311–316). Because of this instability, no firm conclusions can be made about the function of Feature 16. Another hypothesis, for example, is that the rocks might represent a stockpile of raw materials intended for use in cooking pits.

Cultural Materials

Cultural materials recovered from the excavation block comprise chipped stone artifacts (n = 2,075), ground stone artifacts (n = 3), unmodified faunal remains (n = 9), burned rocks (weight = 2,161.25 kg), and unburned rocks (weight = 71.5 kg) (see Table 7.9 and Appendix D). The charred macrobotanical remains (see Appendix B) also provide evidence that diverse plant resources were used.

Chipped Stone Artifacts

The chipped stone artifact category is dominated by 1,999 unmodified flakes (96.3 percent), followed by 64 chipped stone tools (3.1 percent) and 12 cores (0.6 percent). All chipped stone artifacts are produced from fine-grained chert, with 550 specimens (26.5 percent) qualitatively identified as known or observed types at Fort Hood. The remaining 1,525 specimens (73.5 percent) can be attributed only as indeterminate chert types.

ARROW POINTS

One arrow point preform was recovered from Test Unit 32 (Figure 7.18). The specimen is nearly complete and made on a thin decorticate flake of Fort Hood Yellow material (Table 7.10). At the proximal end of the specimen, one lateral edge exhibits use.

DART POINTS

Ten test units produced a total of 15 dart points. Nine specimens are classified to type, and they all represent Late Archaic styles—Ensor, Darl, and Marshall. Only 6 of the dart points could be assigned to a named chert type. Metric data for the dart points are listed in Table 7.7.

Darl

Three complete or nearly complete Darl points are approximately the same length, and the blades are heavily reworked and alternately beveled (see Figure 7.18). The proximal fragment shows multiple impact fractures. The stem edges and bases of several specimens also have been ground.

Ensor

The four Ensor points consist of two complete or nearly complete specimens and two proximal fragments (see Figure 7.18). The complete point is reworked, and its blade is alternately beveled. One proximal fragment shows pot lids from intensive heating, and its blade is serrated and alternately beveled. The second proximal fragment has a lightly ground stem base, and the fragment was used after it was broken.

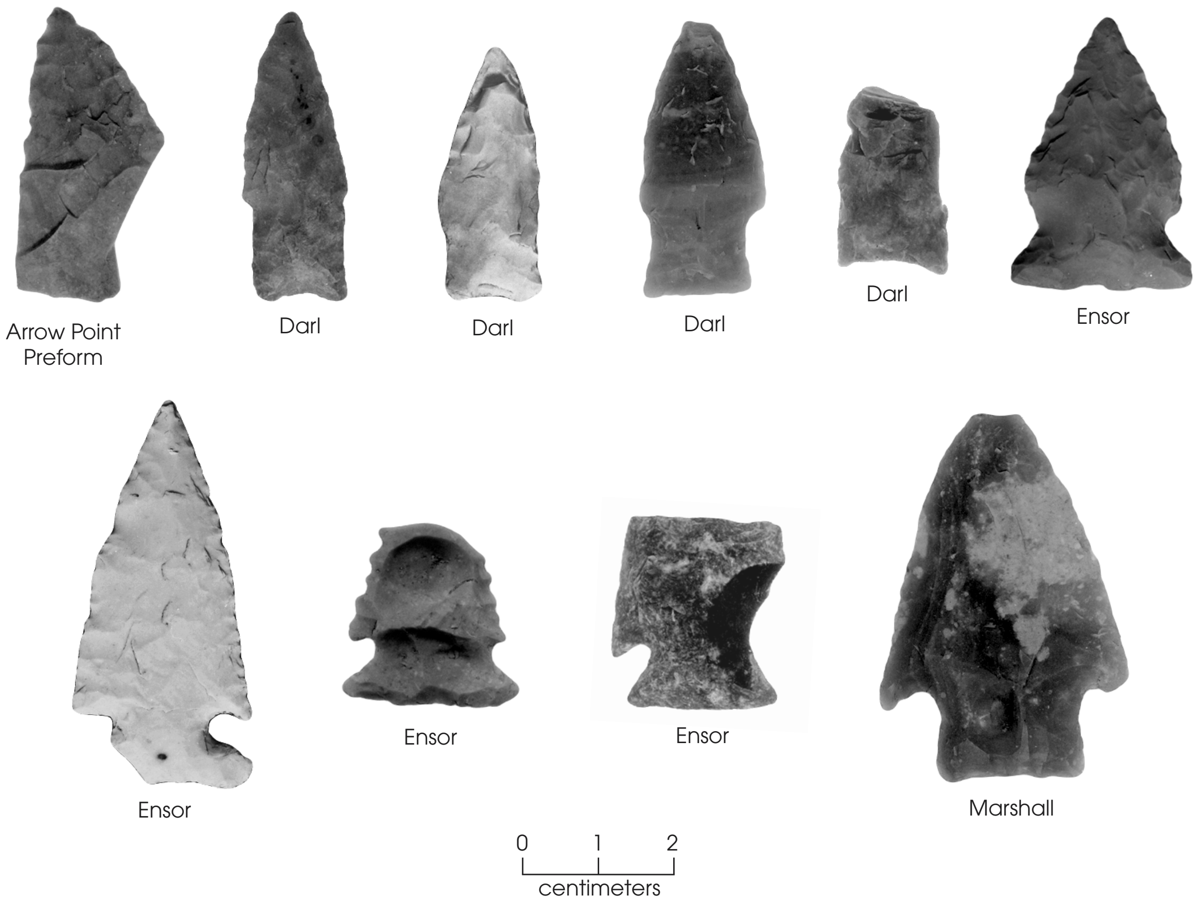


Figure 7.18. Arrow and dart points, Area 2, 41CV595.

Marshall

This nearly complete specimen (see Figure 7.18) reveals a waxy luster indicating heating. A pot lid on the stem indicates that the specimen was probably heated accidentally or discarded into a fire.

Untypeable Dart Points

One proximal, two medial, and three distal fragments comprise the six untypeable dart points. The proximal and one medial fragment are pot lidded, demonstrating exposure to high heat.

BIFACES

As summarized in Table 7.11, the eighteen bifaces are classified as early- to middle-stage (55.6 percent), late-stage to finished (38.9 percent), and miscellaneous (5.5 percent). Seventeen specimens were found in nonfeature contexts, and one early- to middle-stage biface fragment was recovered from Feature 8. Four artifacts are manufactured of Anderson Mountain Gray, Cowhouse White, or Heiner Lake Blue chert types.

All of the early- to middle-stage bifaces are fragments. Each retains less than 50 percent cortex, most indicate a circular or ovate outline, and a few show step fractures (Figure 7.19). Two fragments exhibit reworking along a snapped edge, indicating reuse of broken bifaces.

Of the seven late-stage to finished bifaces, the only complete specimen is a small, triangular biface that measures 23.56x19.85x5.6 mm. One proximal piece is rectangular and fairly thin, possibly a fragment of a finished knife. The remaining five late-stage to finished biface fragments and one miscellaneous biface are nondescript.

Table 7.10. Projectile point provenience and attributes, Area 2, 41CV595

Nonmetric Attributes						Metric Attributes (mm)						
Point Type	Provenience*	Completeness	Identifiable Chert Type	Patination	Heating	Maximum length	Blade length	Blade width	Haft length	Neck width	Base width	Maximum thickness
Arrow point preform	TU 32, 99.40–99.30	nearly complete	Fort Hood Yellow	none	low	39.02	39.02	18.97	–	–	–	3.83
Darl	TU 45, 99.50–99.40	complete	indeterminate white	none	low	34.05	24.50	13.95	10.16	12.21	13.15	5.97
Darl	TU 40, 99.50–99.40	complete	indeterminate light brown	none	none	38.87	25.56	14.46	14.18	12.17	12.65	5.87
Darl	TU 48, 99.28	nearly complete	indeterminate light gray	none	none	36.55	24.92	16.94	10.91	12.69	14.47	6.21
Darl	TU 17, 99.57–99.50	proximal fragment	Heiner Lake Blue	light	none	24.48	14.23	14.78	11.34	14.69	14.97	6.49
Ensor	TU 29, 99.40–99.30	complete	Fort Hood Yellow	none	none	36.54	26.56	21.62	11.58	16.86	24.45	5.84
Ensor	TU 50, 99.38–99.25	nearly complete	indeterminate white	none	none	51.52	41.80	24.13	10.05	12.83	19.40	4.95
Ensor	TU 43, 99.20–99.10	proximal fragment	Anderson Mountain Gray	none	high	24.57	15.83	21.21	9.51	15.63	24.00	4.72
Ensor	TU 16, 99.41	proximal fragment	Owl Creek Black	heavy	none	25.77	19.11	25.02	9.32	13.53	20.45	6.01
Marshall	TU 31, 99.45	nearly complete	indeterminate mottled	light	high	49.70	39.52	33.50	12.45	19.03	19.88	6.70
untypeable	TU 40, 99.40–99.30	proximal fragment	Owl Creek Black	none	high	21.64	–	–	17.79	16.09	21.08	6.45
untypeable	TU 29, 99.70–99.57	medial fragment	Seven Mile Novaculite	light	none	20.53	20.53	18.17	–	–	–	6.50
untypeable	TU 39, 99.30–99.20	medial fragment	indeterminate mottled	light	none	31.29	31.29	33.32	–	–	–	8.87
untypeable	TU 39, 99.58–99.50	distal fragment	indeterminate dark gray	light	high	17.44	–	–	15.04	19.13	–	6.18
untypeable	TU 29, 99.40–99.30	distal fragment	indeterminate dark gray	light	low	38.48	38.48	19.42	–	–	–	4.84
untypeable	TU 40, 99.50–99.40	distal fragment	indeterminate light brown	none	none	22.13	22.13	18.64	–	–	–	5.94

* Measurements are in meters. TU = test unit.

Table 7.11. Biface types by completeness, Area 2, 41CV595

Completeness	Early- to middle-stage	Late-stage to finished	Miscellaneous	Total
Complete	–	1	–	1
Proximal fragment	2	2	–	4
Medial fragment	–	1	–	1
Distal fragment	3	2	–	5
Edge fragment	–	1	–	1
Indeterminate	5	–	1	6
Total	10	7	1	18

UNIFACES

The five unifaces consist of one end scraper, one side scraper, and three miscellaneous unifaces. Notably, all of these artifacts were recovered from five units situated in the southern end of the excavation block.

The complete end scraper measures 93.24x54.76x18.97 mm and is manufactured of Cowhouse White chert (Figure 7.20). The side scraper is an edge fragment showing failed rejuvenation. Both artifacts retain less than 50 percent cortex.

Two miscellaneous unifaces are intentionally trimmed edge fragments lacking cortex. A third nearly complete specimen shows retouch along one distal margin.

SPOKESHAVE

A single spokeshave is a complete specimen from Test Unit 13. It is a small primary flake with a unifacially worked notch.

BURINS

Three test units produced three burins. Two specimens are complete, and one distal fragment is made of Heiner Lake Blue chert. Two of the three artifacts show previous burin removals on their dorsal surfaces.

CORE TOOL

A complete core tool is a multidirectional

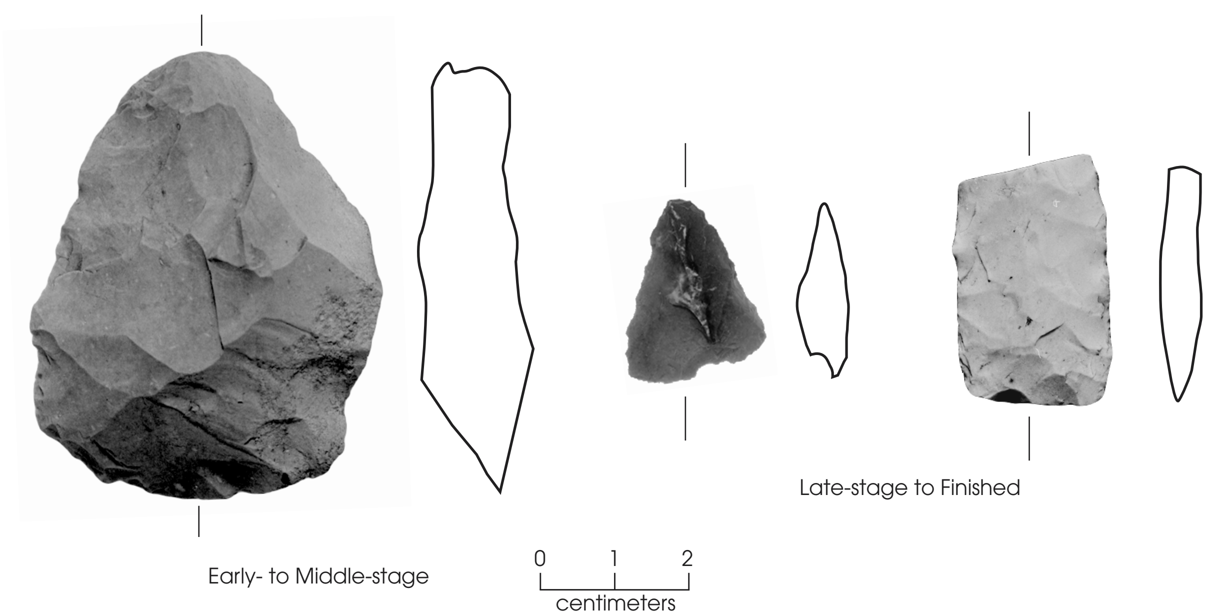


Figure 7.19. Bifaces, Area 2, 41CV595.

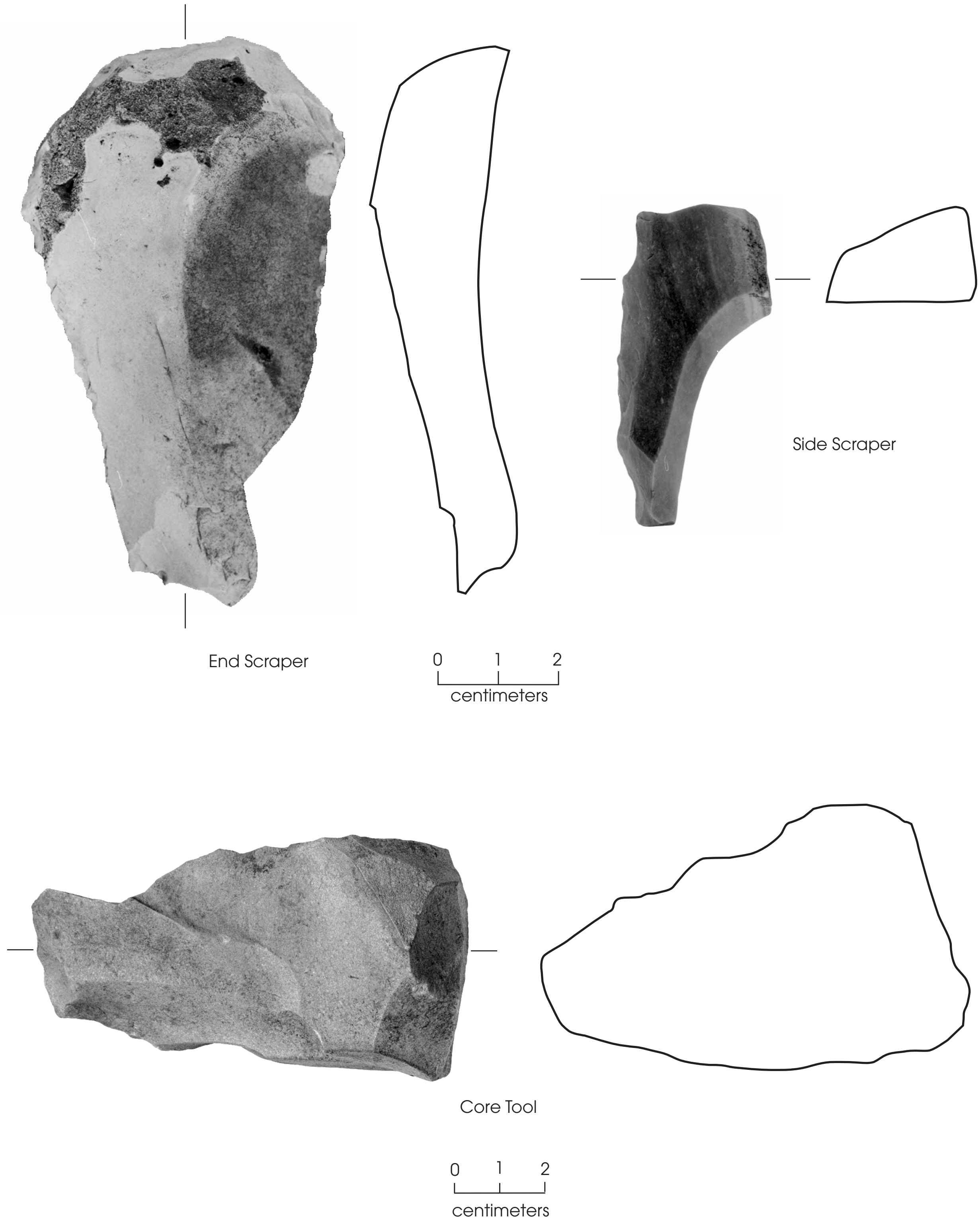


Figure 7.20. Scrapers and core tool, Area 2, 41CV595.

core with contiguous step fractures on the constricting end of the piece and abraded cortex (see Figure 7.20). The apparent working end of the specimen is dulled, and the many stacked step fractures suggest heavy impact use (i.e., pounding or chopping).

EDGE-MODIFIED FLAKES

This artifact class makes up 31.3 percent of the 64 chipped stone tools. The 20 edge-modified flakes consist of 5 complete specimens, as well as proximal, medial, distal, and edge fragments. Three specimens retain more than 50 percent cortex, 8 artifacts have less than 50 percent cortex, and 9 have no cortex. None exhibit evidence of heat treatment. Four edge-modified flakes were recovered from the larger cooking pits—Features 8, 11, and 15—and the rest were scattered in 13 test units. Only 6 specimens are made of identifiable chert types, including Cowhouse White, Anderson Mountain Gray, and two Heiner Lake varieties.

CORES

Of the 12 cores recovered, 10 are complete specimens, and 2 consist of a distal and an indeterminate fragment. Ten appear to be exhausted, multidirectional flake cores. One specimen is a bifacial core ruined by an overshot removal, and another represents an exhausted, unidirectional flake core.

UNMODIFIED DEBITAGE

Unmodified debitage accounts for 96.3 percent of the entire chipped stone assemblage from Area 2. Of the debitage, 177 specimens (8.9 percent) were recovered from feature contexts, although their occurrence within burned rock features is probably fortuitous and not related to the functions of the features. The unmodified flakes consist of 684 (34.2 percent) complete specimens, 309 (15.5 percent) proximal fragments, 978 (48.9 percent) chips, and 28 (1.4 percent) chunks. Noncortical debitage numbers 1,671 (83.6 percent), whereas 328 (16.4 percent) pieces of debitage retain dorsal cortex (Table 7.12).

About 26.3 percent (n = 440) of the flakes can be classified into 14 named chert types. These are dominated by Cowhouse White (n = 216, 49 percent), but Fort Hood Yellow, Heiner Lake Translucent Brown, Anderson Mountain Gray, and Heiner Lake Blue are all well represented.

Ground Stone Artifacts

Three ground stone artifacts consist of a metate (Figure 7.21) and two pitted stones (Figure 7.22). The complete, rectangular metate measures 34.6x29.7x12.7 cm and weighs 101.4 kg. This large unburned piece of fossiliferous limestone has a pronounced concavity on one face. The grinding basin is ovate, has maximum dimensions of 25x18 cm, and is approximately 2 cm deep. The metate was oriented vertically from 99.37 to 98.97 m in Test Unit 25. This artifact probably represents a curated item, perhaps even cached in this upright position, but no evidence of a pit or stained sediment was apparent around it.

Two special studies—one looking for preserved pollen, and the other, for organic residues—were conducted on the metate. A pollen wash was taken from the metate basin and sent to Dr. John G. Jones of the Palynology Laboratory at Texas A&M University. There were fossil pollen grains present, but they were so poorly preserved as to be largely uninterpretable. Environmental conditions in central Texas are not generally conducive to good pollen preservation, and the sandy Paluxy sediments exacerbate this problem.

For the second special study, a small block of limestone was cut from the central portion of the metate's basin using a drill with a cutting drill bit. The sample approximated a 3.5-cm cube but tapered toward its bottom to facilitate removal. The sample was sent to Dr. Mary Malainey of the Department of Native Studies, Brandon University, Manitoba, Canada, for organic residue analysis. The fatty acid residues recovered from this sample (see Appendix C) suggest that the metate was used to grind moderate- to high-fat content foods and low-fat plant foods. The low-fat foods could include onion and camas bulbs, two foods that were found in nearby earth ovens and the burned rock scatter discarded from earth ovens (see Appendix C).

The two other ground stone artifacts are similar in morphology and are termed pitted stones; comparable specimens have been interpreted as nutting stones or anvils. Both consist

Table 7.12. Summary of unmodified debitage by chert type and cortex percentage, Area 2, 41CV595

Chert Type	Cortex 0%	Cortex 1–50%	Cortex 50–99%	Cortex 100%	Total
Anderson Mountain Gray	46	4	2	–	52
Cowhouse Dark Gray	2	1	–	–	3
Cowhouse Mottled	–	1	–	–	1
Cowhouse Streaked	1	1	–	–	2
Cowhouse Two Tone	2	16	1	–	19
Cowhouse White	192	20	3	1	216
Fort Hood Gray	6	1	–	–	7
Fort Hood Yellow	66	14	–	–	80
Gray-Brown-Green	4	3	2	–	9
Heiner Lake Blue	37	5	1	–	43
Heiner Lake Blue-Light	7	3	–	–	10
Heiner Lake Translucent Brown	65	9	–	–	74
Owl Creek Black	12	2	–	–	14
Seven Mile Mountain Novaculite	–	1	–	–	1
Subtotal	440	81	9	1	531
Indeterminate chert types	1,231	191	39	7	1,468
Total	1,671	272	48	8	1,999

of tabular pieces of fossiliferous limestone that reveal a small depression on one face. One complete, large specimen measures 24.9x19.7x5.5 cm and weighs 3.2 kg, and the pitted area has maximum dimensions of 6.2x5.5x1.4 cm. The second artifact is an indeterminate piece 12.3x9.1x3.8 cm (0.6 kg) that is broken along the margin of the depression, which measures 4.3x3.5x1.0 cm. The pitted stones have been heated, suggesting they were reused as hearth stones.

Burned and Unburned Rocks

A total of 2,161.25 kg of burned limestone rocks was found in the excavation block, with eight discrete features yielding 38.7 percent (836.25 kg) of the entire weight. Overall, there were denser amounts of burned rocks in the 20- to 40-cm-thick general level deposits in the southeastern two-thirds of the block area (see Figure 7.9). In addition, accumulations of more than 50 kg within the general burned rock layer occurred primarily just above Features 11 and 15 (cooking pits) and probably represent debris associated with oven cleaning events or portions of heating elements.

All of the limestone rocks brought into Area 2, whether burned or unburned, were probably transported no more than 50 to 100 m. Most burned rocks were fossiliferous limestone that may be found in the Walnut Clay outcrop on the sloping west end of the site and in the channel gravel bars of Stampede Creek immediately to the east of the site. Unburned rocks (71.5 kg) from Feature 16 constitute large pieces of fossiliferous limestone that were intentionally carried to the site area.

Faunal Remains

Unmodified faunal remains consist of only six bone fragments and one mussel shell. Most bones could not be assigned to taxa, but one canid- to deer-sized long bone has been spirally fractured. Features 8 and 11 each produced two bone fragments, and the rest are from general level contexts. The mussel shell is identified as *Amblema plicata*.

Macrobotanical Remains

Twenty-eight flotation and seven charcoal samples collected from feature and nonfeature deposits were submitted for macrobotanical analysis (see Appendix B). Although oak is the most common wood noted in the flotation samples, 16 other identifiable wood taxa, along with bulb and acorn or nut fragments, were identified (see Table 7.8).

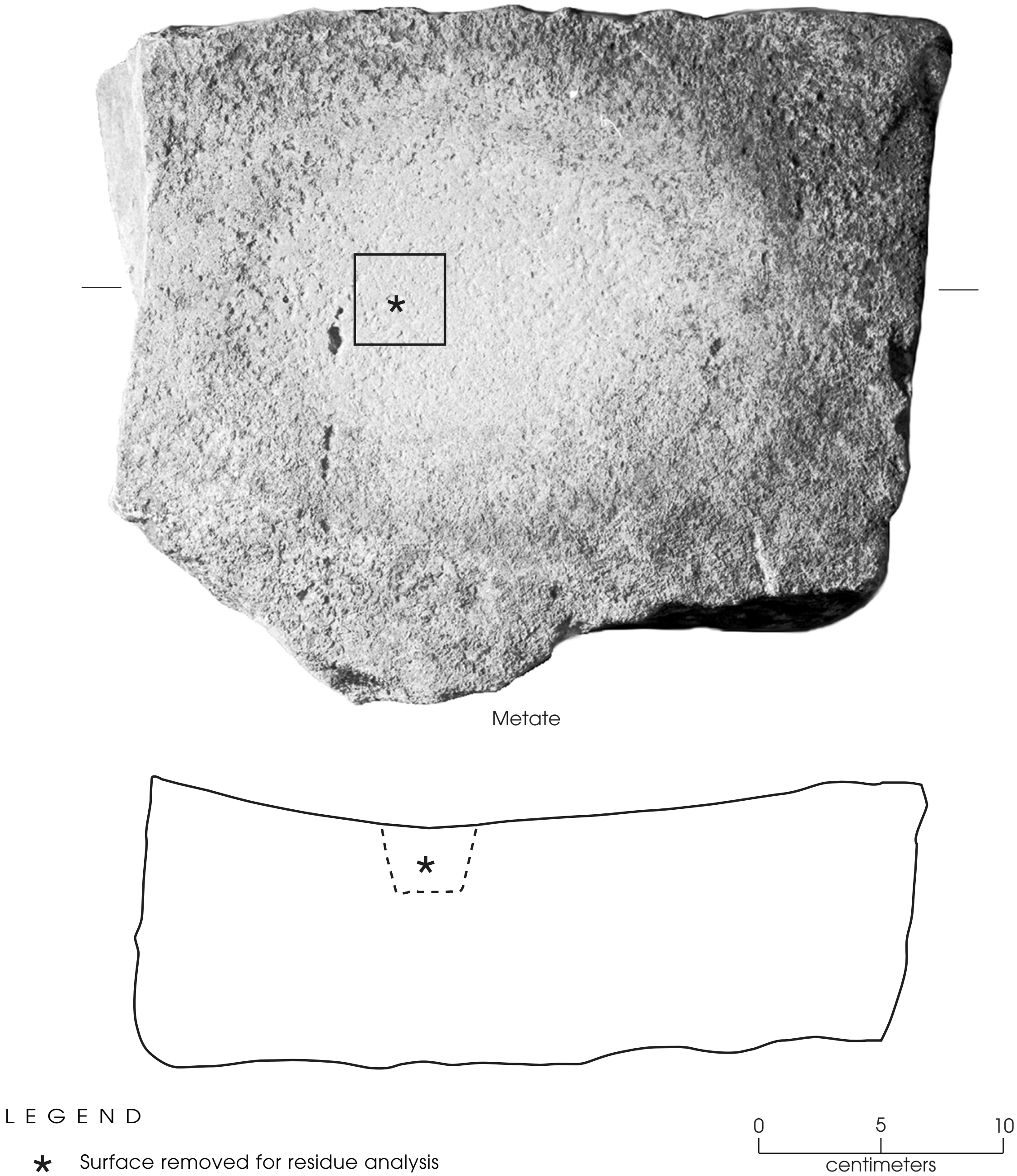


Figure 7.21. Metate, Area 2, 41CV595.

ARCHEOLOGY OF AREA 3

Nineteen test units were excavated adjoining and near Backhoe Trench 7 to investigate burned rock mound Feature 3 (Figure 7.23). Within Area 3, 17 of 19 test units were in groups of three or more units, and two were free-standing units. The ground surface of Area 3 was approximately 3 m lower than Areas 1 and 2, and the units were excavated between 96.37 and 95.22 m (Figure 7.24). Overall, the deposits ranged from 44 to 85 cm thick. One mature post oak and other scrub vegetation were present in this area, and no evidence of clearing or obvious disturbance was apparent. Seven test units, however, did contain military (bullets and ammunition magazines) and modern (e.g., plastic and an armadillo ulna) items in the upper 20 cm of

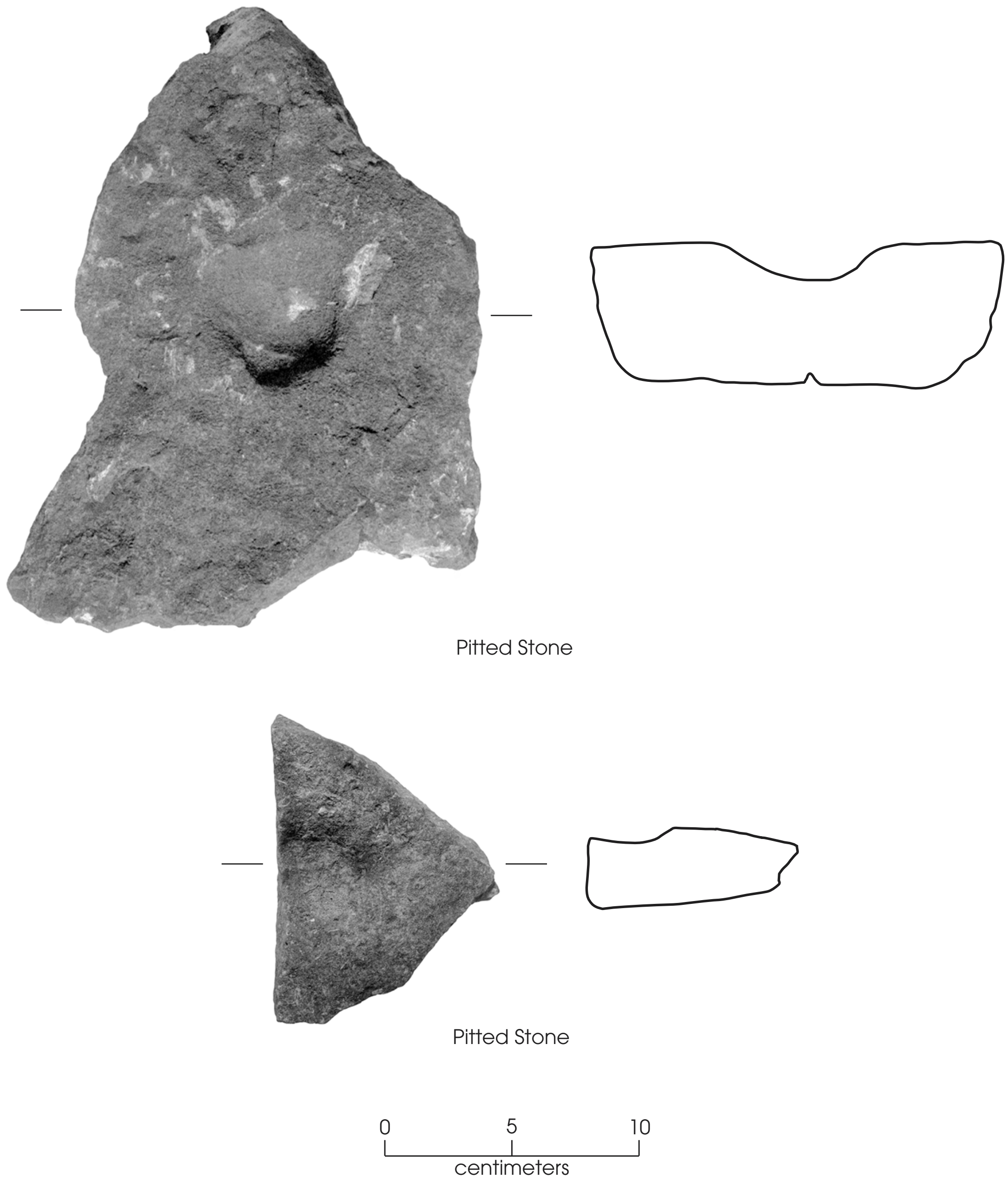


Figure 7.22. Pitted stones, Area 2, 41CV595.

deposit, indicating portions of Area 3 were compromised. Bioturbation by roots and insects was also observed.

Thirteen units focused on the western half of Feature 3, with most concentrated in the central portion of the mound around Feature 4, an internal cooking pit. Two more burned rock features (Features 5 and 9) were encountered just beyond the western margin of the mound. Figure 7.25 shows the locations of the features in relation to the excavations, as well as with the horizontal distributions of feature-related and nonfeature burned rocks. Figure 7.26 shows the distributions of all artifacts recovered from feature and nonfeature contexts. Although the mound yielded 87.3 percent of the burned rocks (by weight) found in Area 3, the artifact totals from Feature 3 and all other contexts were fairly comparable (Table 7.13). It should be noted, however, that the occurrence of artifacts within areas defined as features is an association by location but does not denote a functional

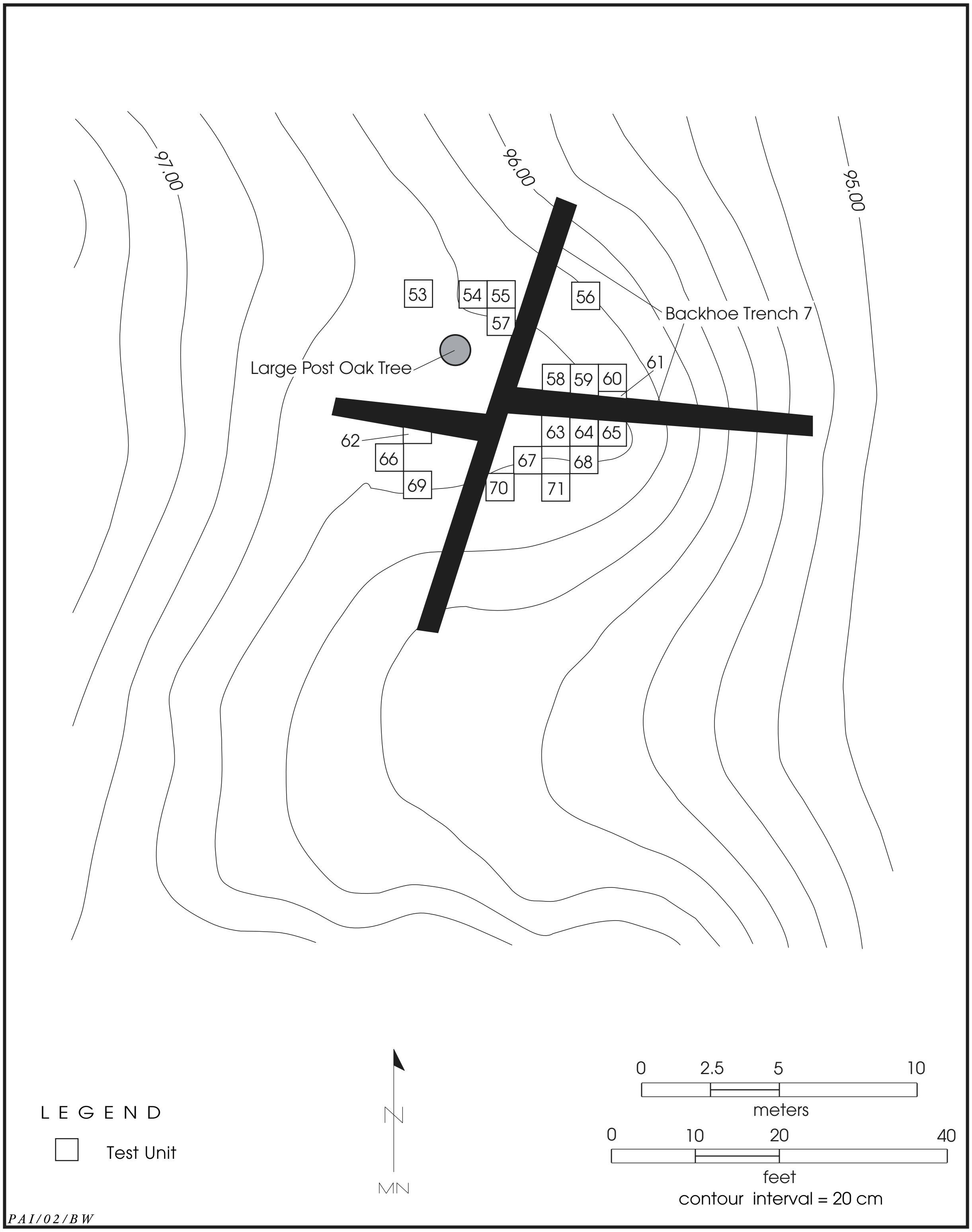


Figure 7.23. Overview of excavations in Area 3, 41CV595.

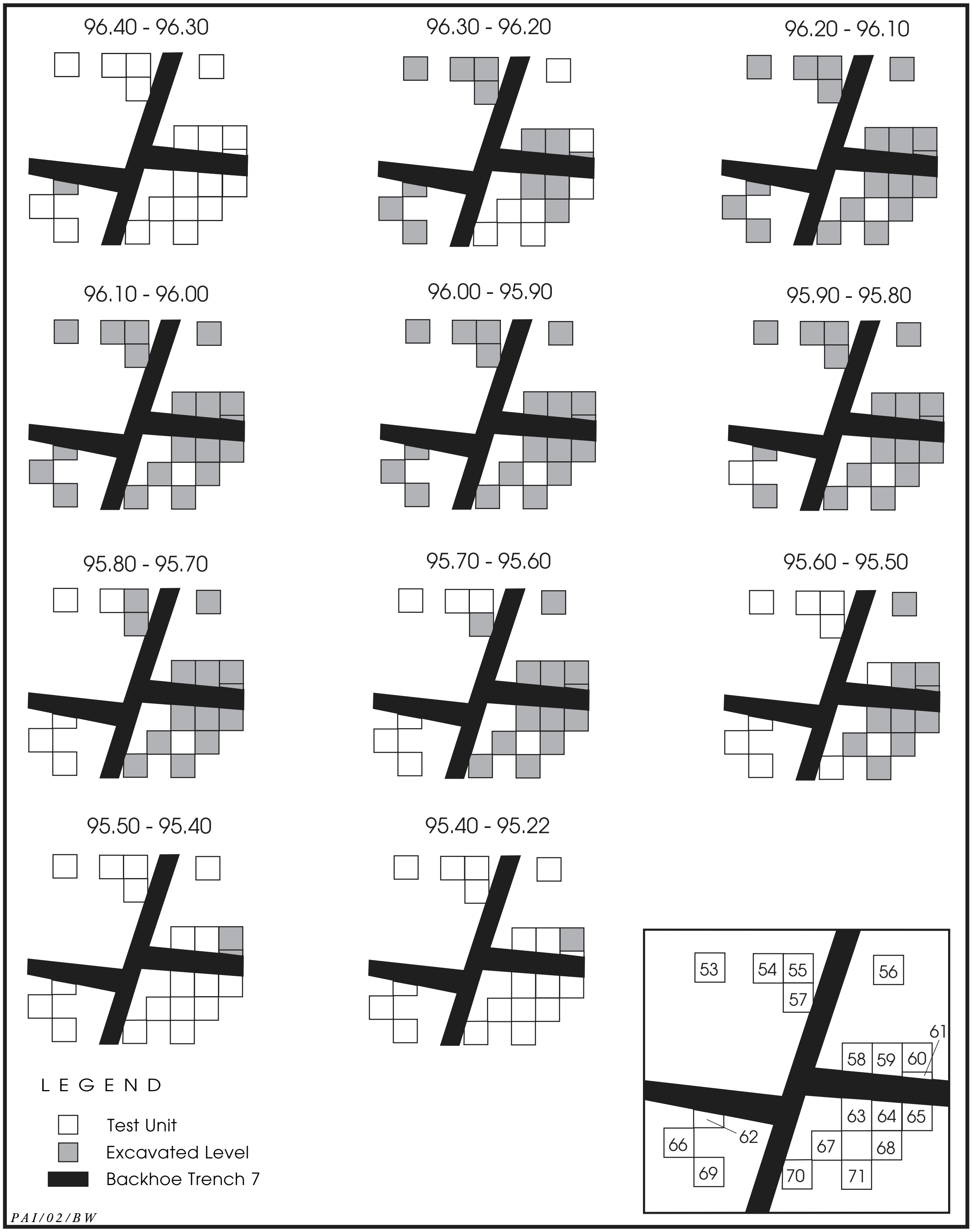


Figure 7.24. Vertical distribution of all excavation levels within Area 3, 41CV595. The distribution covers 11 layers (each 10 cm thick) from 96.40 to 95.22 m across the excavation block (includes partial levels of less than 10 cm).

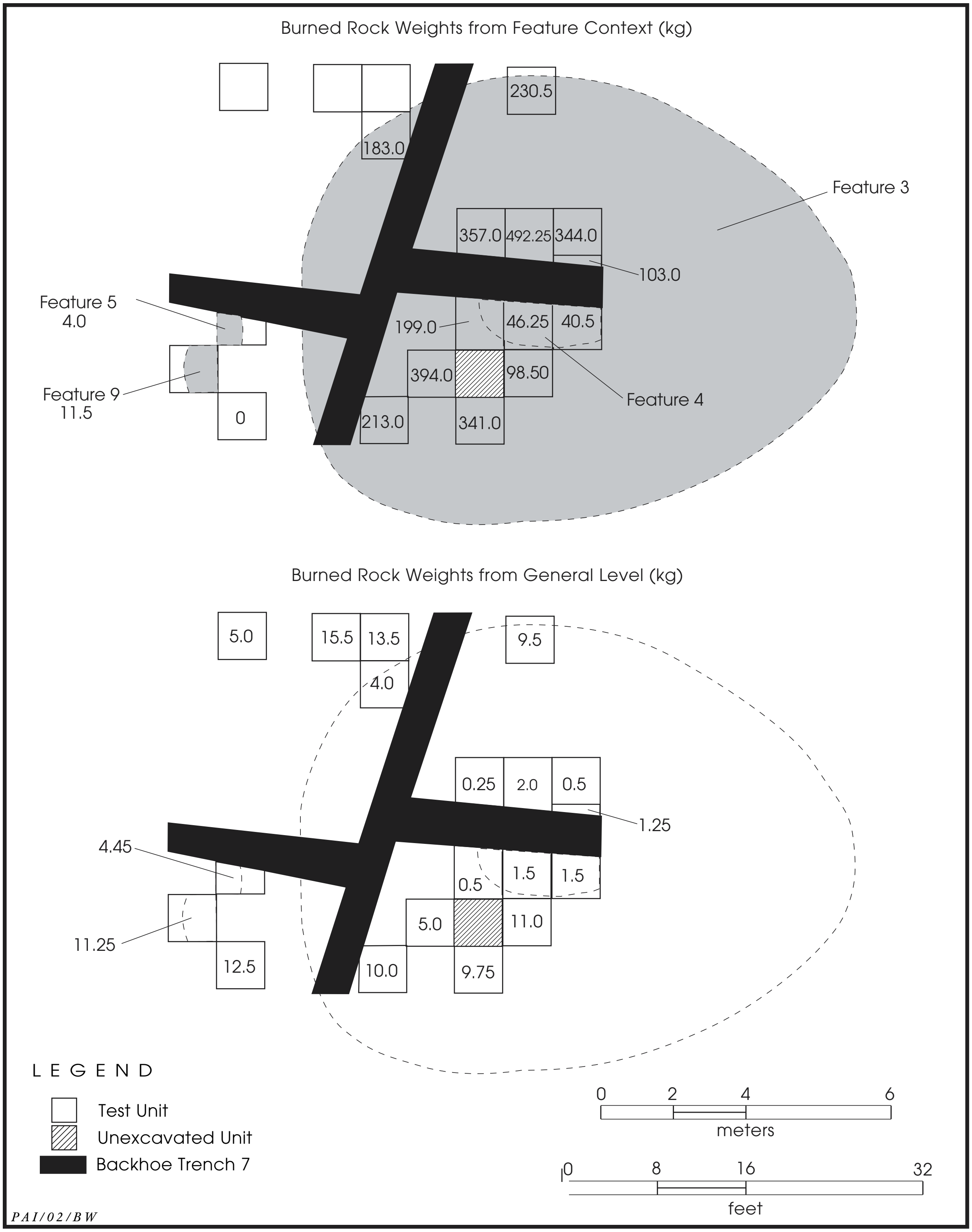


Figure 7.25. Horizontal distributions of burned rocks in Area 3, 41CV595.

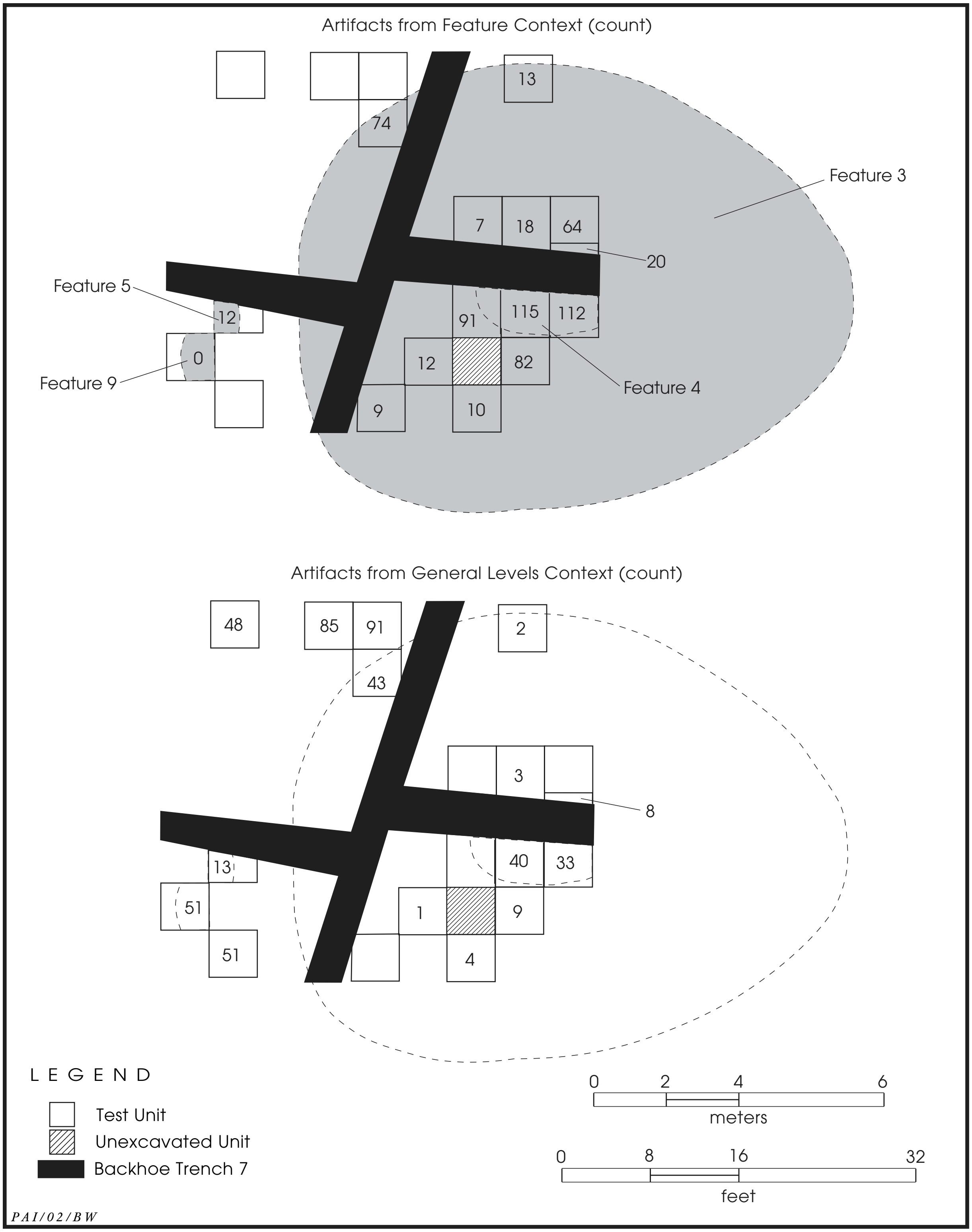


Figure 7.26. Horizontal distributions of artifacts in Area 3, 41CV595.

Table 7.13. Cultural materials, Area 3, 41CV595, by test unit

		Artifacts														Faunal Remains		Burned Rocks	
Test Unit	Feature	Arrow points	Dart points	Dart point preform	Perforator	Early- to middle-stage bifaces	Late-stage to finished bifaces	End scraper	Miscellaneous uniface	Spoke shave	Core tool	Edge-modified flakes	Cores	Unmodified debitage	Artifact total	Unmodified bone	Unmodified shell	Count	Weight (kg)
56	3	–	–	–	–	–	–	–	–	–	–	–	1	12	13	–	–	984	230.5
57	3	–	–	–	–	–	–	–	–	–	–	1	–	73	74	–	–	1,010	183.0
58	3	–	–	–	–	–	–	–	–	–	–	1	–	6	7	–	–	2,082	357.0
59	3	–	–	–	–	–	–	–	–	–	–	1	–	17	18	–	–	3,319	492.3
60	3	–	–	1	–	2	1	–	–	–	–	1	–	59	64	–	–	2,465	344.0
61	3	–	–	–	–	–	–	–	–	–	–	–	–	20	20	–	–	900	103.0
63	3	–	–	–	1	1	–	–	–	–	–	2	1	86	91	1	–	2,959	199.0
64	3	1	1	–	–	1	–	1	–	–	–	–	–	111	115	–	1	461	46.3
65	3	1	–	–	–	2	–	–	1	–	–	–	–	108	112	–	–	478	40.5
67	3	–	–	–	–	–	–	–	–	–	–	–	–	12	12	–	–	1,957	394.0
68	3	–	–	–	–	–	–	–	–	–	–	–	–	82	82	–	–	528	98.5
70	3	–	–	–	–	–	–	–	–	–	–	1	–	8	9	–	–	1,196	213.0
71	3	–	–	–	–	–	–	–	–	–	–	–	–	10	10	–	–	1,776	341.0
Subtotal		2	1	1	1	6	1	1	1	0	0	7	2	604	627	1	1	20,115	3,042.0
63, 64, 65	4	–	–	–	–	–	–	–	–	–	–	–	–	71	71	–	–	367	306.5
62	5	–	–	–	–	–	–	–	–	–	–	–	–	12	12	–	–	18	4.0
66	9	–	–	–	–	–	–	–	–	–	–	–	–	0	0	–	–	–	11.5
Subtotal		0	0	0	0	0	0	0	0	0	0	0	0	83	83	0	0	408	322.0
–	–	–	1*	–	–	–	–	–	–	–	–	–	–	–	1	–	–		
53	–	–	1	–	–	–	–	–	–	–	–	2	–	45	48	–	–	19	5.0
54	–	–	–	–	–	3	–	–	–	–	–	2	–	80	85	–	–	45	15.5

Table 7.13, continued

		Artifacts														Faunal Remains		Burned Rocks	
Test Unit	Feature	Arrow points	Dart points	Dart point preform	Perforator	Early- to middle-stage bifaces	Late-stage to finished bifaces	End scraper	Miscellaneous uniface	Spoke shave	Core tool	Edge-modified flakes	Cores	Unmodified debitage	Artifact total	Unmodified bone	Unmodified shell	Count	Weight (kg)
55	–	–	–	–	–	1	–	–	–	–	–	–	–	90	91	–	–	130	13.5
56	–	–	–	–	–	–	–	–	–	–	–	–	–	2	2	–	–	45	9.5
57	–	–	–	–	–	–	–	–	–	1	1	2	–	39	43	–	–	41	4.0
58	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	–	–	5	0.3
59	–	–	–	–	–	–	–	–	–	–	–	–	–	3	3	–	–	23	2.0
60	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	–	–	6	0.5
61	–	–	1	–	–	–	–	–	–	–	–	–	–	7	8	–	–	31	1.3
62	–	–	2	–	–	1	–	–	–	–	–	–	–	10	13	–	–	33	4.5
63	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	–	–	15	0.5
64	–	2	1	–	–	–	–	–	–	–	–	1	–	36	40	–	–	26	1.5
65	–	–	1	–	–	–	–	–	–	–	–	1	–	31	33	–	–	27	1.5
66	–	–	1	–	–	–	1	–	–	–	–	–	–	49	51	–	–	73	11.3
67	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	–	47	5.0
68	–	–	–	–	–	–	–	–	–	–	–	–	–	9	9	–	–	87	11.0
69	–	–	1	–	–	–	2	–	–	–	–	1	–	47	51	–	–	57	12.5
70	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	–	–	35	10.0
71	–	–	–	–	–	–	–	–	–	–	–	–	–	4	4	–	–	73	9.8
Subtotal		2	9	0	0	5	3	0	0	1	1	9	0	453	483	0	0	818	119.2
Total		4	10	1	1	11	4	1	1	1	1	16	2	1,140	1,193	1	1	21,341	3,483.2

Note: Dart point found in Backhoe Trench 7 backdirt.

relationship. In fact, the artifacts within the features almost certainly represent materials that were simply discarded in and around the growing mass of burned rocks that make up the mound. Thus, the artifacts represent other activities and are not associated with the heating and cooking activities that the burned rocks represent.

Flotation samples were collected from the four features, but only Features 3 and 4 yielded charred floral remains (see Appendix B). Albeit sparsely, these two features yielded the only archeological faunal materials. There were no charred macrobotanical remains present in flotation samples recovered from Features 5 or 9. Also, one unprovenienced Ensor dart point was collected from the backdirt of Backhoe Trench 7. It is almost certainly associated with Feature 3, the burned rock mound.

Cultural Features

Feature 3 is a well-defined, ovate burned rock mound having maximum dimensions of 12 m east-west by 9 m north-south. The feature was protected from damage during the firebreak clearing because it is situated beneath the canopy of a very large post oak tree. No central depression was visible on the surface. The middle portion of the feature rested on bedrock but was underlain by an argillic horizon toward the perimeter. Backhoe Trench 7 crossed the western portion of the mound, and then 13 test units sampled all or part of the feature. The edges of Feature 3 were clearly demarcated in various sections of the trench cut and in Test Units 56 and 57. The contact was a contrast between very dark, organic-rich feature matrix and. a pale brown sandy loam. Feature 3 was present between 96.26 and 95.50 m, but thickness of the mound varied. The burned rock deposits were approximately 30–40 thick across the western half of the mound, but they were up to 70 cm thick in the area immediately north of Feature 4 (see below).

Near the edges of the mound, the burned rocks were approximately 30 to 40 cm thick. Artifacts from the mound consisted of 21 stone tools, 2 cores, and 604 pieces of debitage, with the upper 20 cm of fill in each unit accounting for nearly 75 percent of the items recovered. Temporally diagnostic materials were composed of one Alba and one Perdiz, along with an untyped dart point that resembles a Darl and a Darl point preform. Present in separate but contiguous units, the proximal fragment of the Perdiz arrow point refit with a distal fragment recovered from a nonfeature context. Test Units 63–65 and 68 contained 30- to 60-cm thick deposits that produced almost 64 percent (n = 400) of the entire lithic assemblage; these four excavations were also around earth oven Feature 4. As mentioned above, these artifacts (including the Perdiz point fragments) probably represent discarded lithic debris and are not related to the cooking function of the earth oven or the burned rock mound.

The excavations in the mound yielded 20,115 burned rocks (3,042 kg), with approximately 40 percent of the rocks (by number or by weight) coming from the thicker deposits north of Feature 4 in Test Units 58–60. Five other excavations contained high numbers (more than 1,000) of burned rocks, but only those in Test Units 67 and 71 had weights equivalent to those found in Test Units 58—60, which implies that the burned rocks closest to the earth oven are larger and less fractured than the burned rocks elsewhere in the mound. Nonetheless, most burned rocks in the mound were fist-sized and smaller, angular pieces of fossiliferous limestone.

Faunal remains consisted of one bone fragment and one mussel shell, and both specimens were unmodified and unidentifiable. Seventeen flotation samples of general mound matrix were collected from six excavations. Of these, six samples obtained from Test Units 63 and 64 produced box elder, oak, willow, and indeterminate woods. Most disturbance was from root intrusion and animal bioturbation, but military items were found in the upper 10 cm of fill in Test Unit 67.

Feature 4 consisted of a large, rock-lined pit centrally located within Feature 3. It is interpreted as an earth oven within the larger burned rock mound. Backhoe Trench 7 crossed the north edge of the feature, and Feature 4 rocks were clearly visible in the trench's south wall because they were much larger than the burned rocks that make up most of the mound. The rock-lined pit was encountered from 95.98 to 95.55 m in Test Units 63, 64, 65, and 68, and the top of the feature was approximately 20–30 cm below the ground surface on top of the mound (Figure 7.27). Its maximum excavated dimensions were 260 cm east-west by 120 cm north-south.

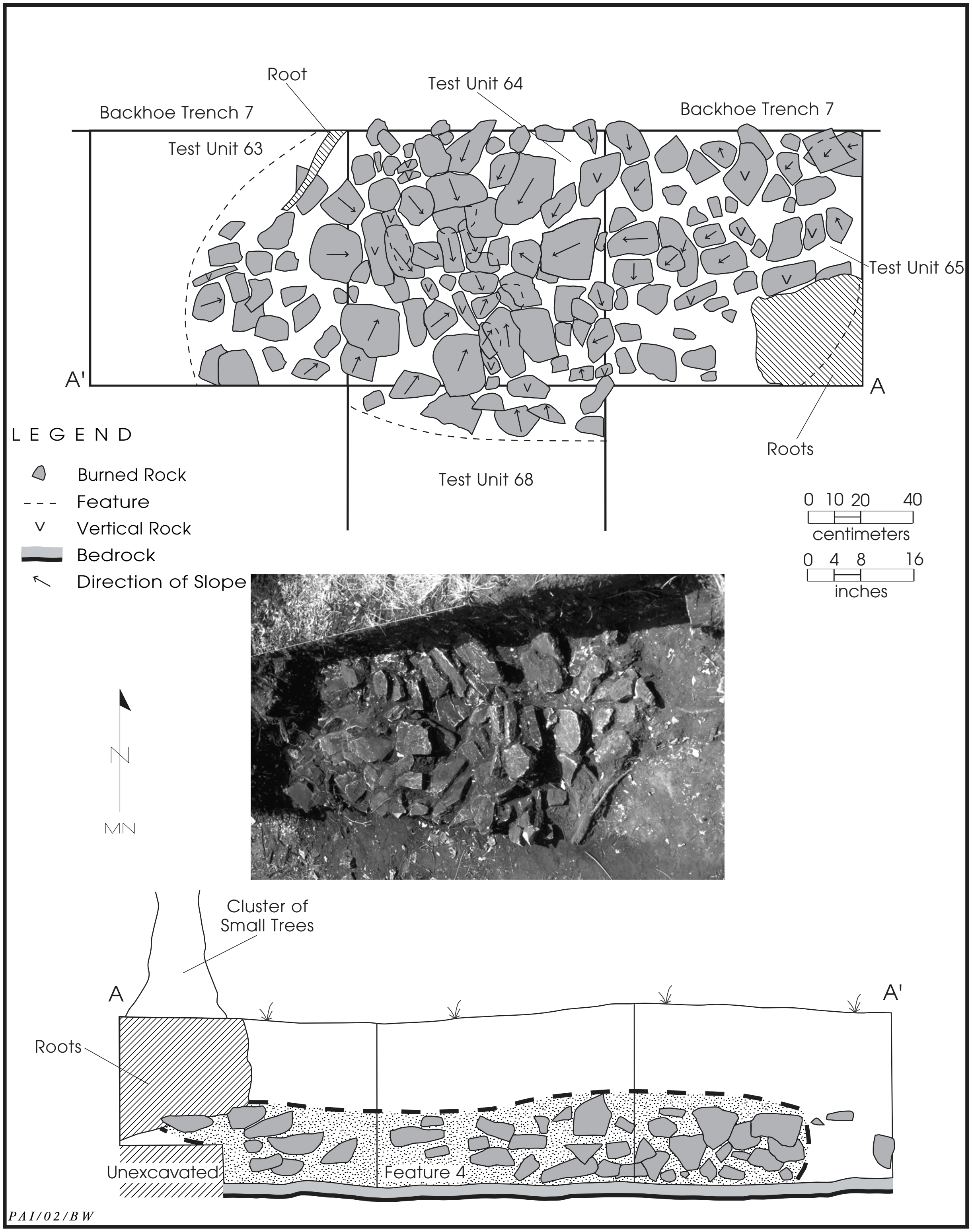


Figure 7.27. Plan, photograph, and profile of Feature 4 in Area 3, 41CV595. Plan view of burned rocks exposed in Test Units 63, 64, 65, and 68 from 95.98 to 95.60 m; photograph is view west of Feature 4 in Test Units 63, 64, and 65; profile is of the south wall of Test Units 63, 64, and 65.

Feature 4 extended across Test Units 64 and 65, but its western and southern edges were demarcated in Test Units 63 and 68. The most obvious disturbance was an extensive tree root mass in the southeast quadrant of Test Unit 65.

The pit comprised two to three layers of burned rocks (n = 367, 306.5 kg), and 90 percent were fossiliferous limestone. Many rocks sloped toward the center of the feature, and several vertical rocks appeared to be randomly scattered. There were almost equal numbers of tabular or very blocky, angular rocks 5–15 cm (n = 158) and 15–25 cm (n = 147) in size present, but the larger rocks weighed about 3.5 times more than the smaller pieces. On average, one-fourth of the rocks in each of these two size categories consisted of unbroken nodules. Fifteen slabs measured up to 38x28x5 cm, and most of these were complete. The remaining rocks were very small angular fragments.

The feature fill produced 71 flakes and 1 burned unidentifiable bone fragment. Two flotation samples contained oak and pecan wood. Charcoal recovered from the flotation of feature matrix between 95.98 to 95.55 m yielded a conventional radiocarbon age of 2510 ± 40 B.P. (Beta 149094).

Judging by the excavation and exposures, the complete pit is estimated to have been 300 cm east-west by 180 cm north-south. The feature did not appear in test units placed along the north wall of the trench but was still visible in the south walls of Test Units 63 and 65, along with the east wall of Test Unit 65. Although the pit rested on an irregular bedrock surface, it was not constructed over a natural depression.

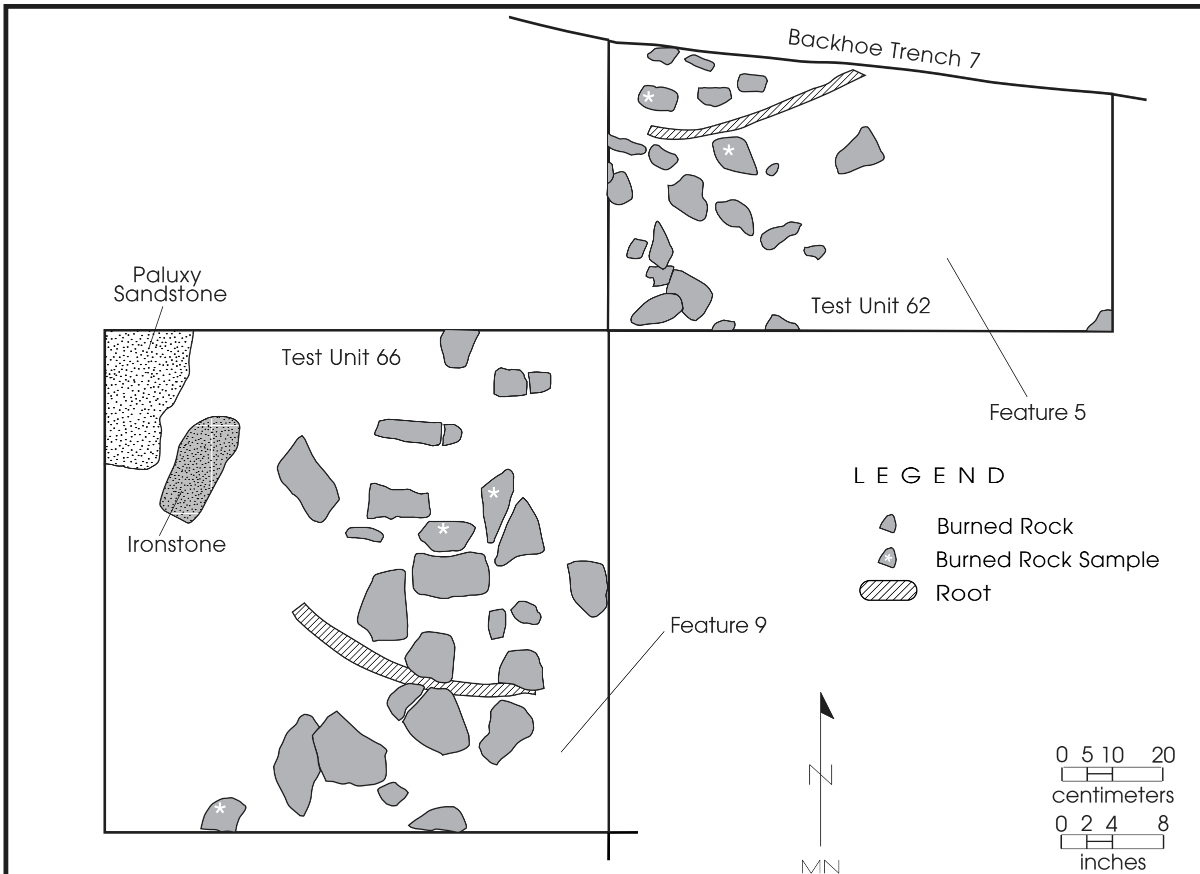
Feature 5 was encountered from 96.03 to 95.92 m in Test Unit 62, and Feature 9 occurred from 96.1 to 96.0 m in the adjacent Test Unit 66 (Figure 7.28). Judging by their close proximity and similarities, these two burned rock concentrations are probably the same feature. Feature 5 was exposed in the south wall of Backhoe Trench 7, and Test Unit 62 exposed a single layer of 18 fossiliferous burned rocks (4 kg) that were 5–15 cm in size. Confined to the western half of the unit, the feature had maximum excavated dimensions of 57x57 cm. The feature fill yielded 12 flakes. Contained primarily in the eastern half of Test Unit 66, Feature 9 also comprised a single layer of burned rocks (n = 23, 11.5 kg). All of the rocks were fossiliferous pieces of limestone that measured 5–15 cm. No artifacts were recovered from the feature matrix. Feature 9 did not extend into Test Unit 69.

Features 5 and 9 both rested on the rubified B horizon and were disturbed by medium-sized roots. No organic stained sediments were observed, and flotation samples contained no charred floral remains. Organic residues were extracted from two Feature 5 burned rocks and analyzed (see Appendix C). The maximum dimensions of Features 5 and 9 could not be determined because the burned rocks extended beyond the limits of the excavations.

When the two features are considered as one, it appears to be an ovate cluster that measures a little more than 2 m north-south by 1 m east-west. All of the burned rocks fall into the 5- to 15-cm size range, and most are approximately fist sized. The Feature 5–9 burned rocks are unusual in that they are almost all complete cobbles that are rounded or tabular with rounded edges. They are identical to the stream cobbles observed in the bedload channel gravels of Stampede Creek immediately east of the site, and the rocks were almost certainly obtained from that source.

In contrast, the burned rocks scattered throughout the Feature 3 mound are mostly angular with fractures caused by intensive or repeated heating episodes. All of the Feature 5–9 rocks are discolored (reddened or blackened) by heating, but they were not heated intensively enough to cause fracturing. The precise function of these rocks is uncertain, but the lack of evidence for in situ heating (i.e., the absence of charcoal or organic soil staining) and the random, patternless distribution suggests that they represent a dump site, most likely a single episode. One possible explanation is that these burned rocks represent a dump of boiling stones.

An experiment conducted using 11 fist-sized stream cobbles collected from Stampede Creek (about 30 due east of the Firebreak site) suggests that the homogenous rocks in Features 5–9 would have made good boiling stones. The experimental stones were heated in a controlled fire that reached temperatures of more than 350°C (600°F) for more than two hours. The 11 hot stones were then picked out of the fire and placed, one at a time, in a metal container with 1.89 liters (2 quarts) of water. The water reached the boiling point (100°C; 212°F) when the fourth stone was placed in the container. Once all the



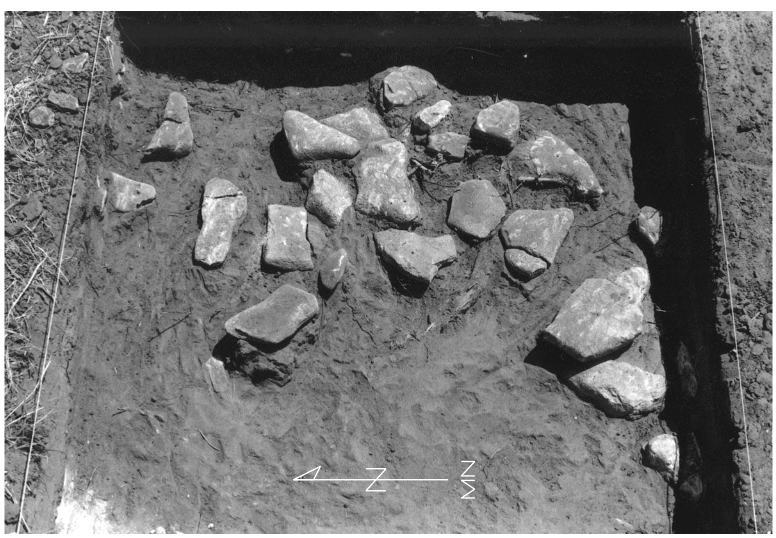


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Figure 7.28. Plan of Feature 5 in Test Unit 62 from 96.03 to 95.92 m and Feature 9 in Test Unit 66 from 96.10 to 96.00 m, Area 3, 41CV595.

stones were added, the water boiled for more than 5 minutes, but the maximum temperature the water reached was only about 105°C (221°F). The water stayed at or above 94°C (200°F) for almost 15 minutes, however. The collected cobbles were indeed good boiling stones and only one of them—the smallest of the 11 stones—cracked from heating or cooling. The other 10 rocks, although blackened by charcoal and reddened by the fire, were in good shape.

A second boiling experiment was done using these 10 rocks and identical methods. The results of this boiling episode were virtually identical also. One smaller stone cracked, but the other 9 became blacker and redder but were completely intact.

Cultural Materials

The cultural materials predominantly consist of chipped stone artifacts (n = 1,193) and burned rocks (weight = 3,482.95 kg) (see Table 7.13 and Appendix C). Sparse faunal and floral remains were also recovered.

Chipped Stone Artifacts

A total of 1,140 pieces of unmodified debitage make up 95.5 percent of the chipped stone artifacts. The rest of the assemblage includes 51 chipped stone tools (4.3 percent) and 2 cores (0.2 percent). All chipped stone artifacts are produced from fine-grained chert, and 257 specimens (21.5 percent) can be qualitatively correlated to the Fort Hood chert taxonomy. The remaining specimens (n = 936, 78.5 percent) are assigned to indeterminate chert types.

ARROW POINTS

Test Unit 64 produced two Alba points and one untypeable arrow point fragment, and Test Unit 65 contained one Perdiz point (Figure 7.29). All were recovered above, or in the upper portion of, Feature 3. The Alba points are a complete specimen and one heat-treated proximal fragment, and the blades of both points are serrated. The Perdiz point is a proximal fragment that refit with the untypeable distal point fragment to form a complete point that is unifacially worked and manufactured of heat-treated Fort Hood Yellow chert. These two specimens were recovered from contiguous units at different elevations. One was found in the burned rock mound deposits and the other is from a nonfeature context. Metric data on these four specimens are presented in Table 7.14.

DART POINTS

Ten dart points and a preform were recovered from Feature 3 and nonfeature contexts in eight different test units and Backhoe Trench 7. Eight diagnostic points and the preform represent the Late Archaic style points, with a preponderance of Ensor points (see Table 7.14). Only 4 of the points are identified to chert type.

Darl

Two Darl dart points were found. One small (32.89 mm long), complete specimen is reworked and has an alternately beveled blade (Figure 7.30). In contrast, the second specimen is a proximal fragment of a preform that has a maximum length of 64.38 mm. It appears to be a preform for a Darl point.

Ensor

The six Ensor points include one complete and one nearly complete specimen, as well as four proximal fragments (Figure 7.31). The base of the complete artifact is notched on only one side, and the nearly complete specimen is made of Fort Hood Gray chert and shows intentional heat treatment. On the nearly complete specimen, different degrees of glossiness on different flake scars indicate staged heat treatment. Of the four proximal fragments, one specimen with

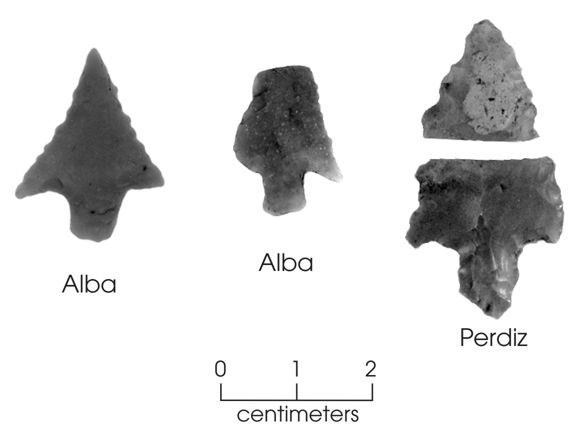

Figure 7.29. Arrow points, Area 3, 41CV595.

Table 7.14. Projectile point provenience and attributes, Area 3, 41CV595

Nonmetric Attributes						Metric Attributes (mm)						
Point Type	Provenience*	Completeness	Chert Type	Patination	Heating	Maximum length	Blade length	Blade width	Haft length	Neck width	Base width	Maximum thickness
ARROW POINTS												
Alba	TU 64, 96.00–95.90	complete	indeterminate light brown	none	none	26.33	19.73	20.15	7.23	7.13	6.67	3.55
Alba	TU 64, 96.20–96.10	proximal fragment	indeterminate light brown	none	low	20.08	–	–	5.73	5.58	6.01	3.61
Perdiz**	TU 65, 96.10–96.00	proximal fragment	Fort Hood Yellow	none	low	17.45	–	16.45	8.65	6.93	6.60	3.02
Untypeable**	TU 64, 96.20–96.10	distal	Fort Hood Yellow	none	low	13.07	–	–	–	–	–	2.70
DART POINTS												
Darl	TU 65, 96.20–96.10	complete	indeterminate light gray	light	none	32.89	23.81	15.04	10.30	9.64	11.93	4.86
Preform (Darl)	TU 60, 95.60–95.50	proximal fragment	indeterminate dark brown	none	none	64.38	–	26.27	12.80	18.26	16.76	9.82
Ensor	TU 61, 96.20–96.10	complete	indeterminate dark gray	none	none	42.53	33.82	20.85	8.95	16.35	21.05	5.71
Ensor	Backhoe Trench 7	nearly complete	Fort Hood Gray	none	low	53.91	44.09	24.86	9.08	14.73	19.82	6.28
Ensor	TU 69, 96.20–96.10	proximal fragment	Cowhouse White	none	low	32.41	–	26.01	10.80	16.48	23.21	6.92
Ensor	TU 53, 96.20–96.10	proximal fragment	indeterminate light gray	none	low	32.35	–	21.09	10.81	13.52	–	6.87
Ensor	TU 62, 96.20–96.10	proximal fragment	indeterminate red	none	high	19.04	–	23.05	10.61	16.59	22.20	6.46
Ensor	TU 62, 96.20–96.10	proximal fragment	indeterminate light gray	light	none	17.38	–	–	8.32	16.47	20.55	6.26
Marshall	TU62, 96.20–96.10	nearly complete	Fort Hood Gray	none	none	56.14	44.85	34.08	11.77	17.29	18.63	6.76
Untyped	TU 64, 96.00–95.90	medial fragment	Heiner Lake Tan	none	low	33.54	–	–	–	–	–	5.86
Untypeable	TU 66, 96.27–96.20	distal fragment	indeterminate light brown	none	low	34.73	–	–	–	–	–	7.18

* Measurements are in meters. TU = test unit.
** These two specimens refit to form a complete Perdiz point.

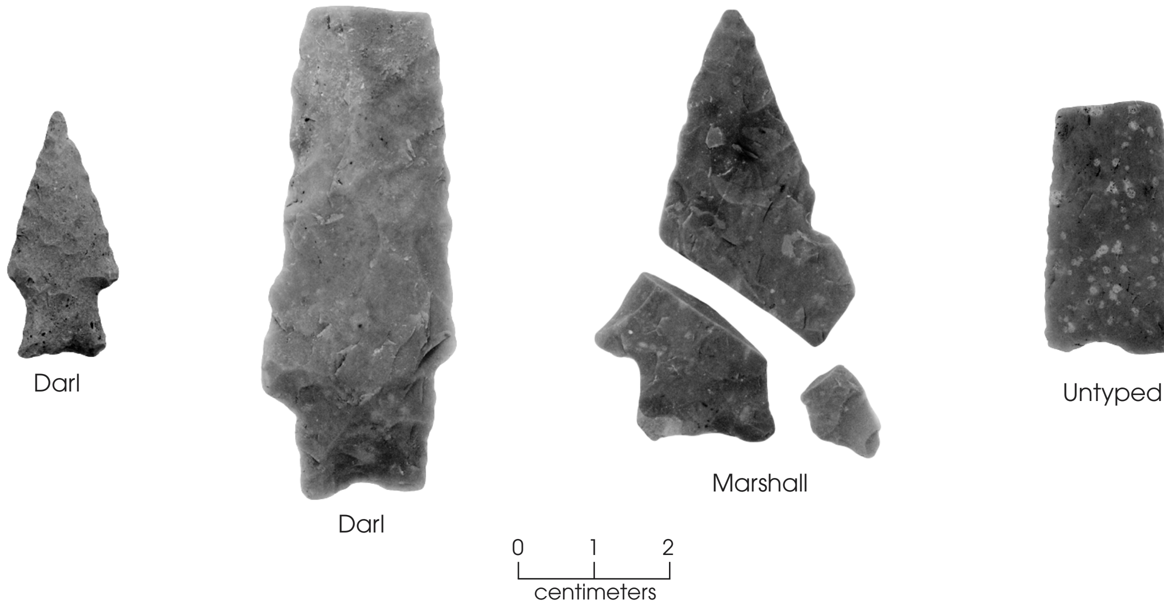

Figure 7.30. Dart points, Area 3, 41CV595.

an alternately beveled and serrated blade is manufactured of Cowhouse White.

Marshall

A single Marshall point is made of Fort Hood Gray chert. It is nearly complete but was broken into three pieces during excavation (see Figure 7.30).

Untyped and Untypeable Dart Points

The untyped dart point is a medial fragment with an alternately beveled and serrated blade (see Figure 7.30). Made from Heiner Lake Tan chert, this specimen is similar to a Darl point. One untypeable dart point is a distal fragment, and the snapped edge shows a luster different from the surface of the blade.

PERFORATOR

One perforator is a distal fragment that appears to have been completed and later broken.

BIFACES

This group comprises 11 early- to middle-stage and 4 late-stage to finished bifaces, but none of the specimens are complete (Table 7.15). Each artifact retains less than 50 percent cortex. One early- to middle-stage biface is manufactured from Anderson Mountain Gray chert, and 1 late-stage to finished edge fragment possibly was used as a burin.

UNIFACES

One distal fragment of an end scraper (Figure 7.32) and the proximal fragment of a miscellaneous uniface make up this category.

SPOKESHAVE

One complete spokeshave is made from a natural concavity on a small tabular cobble. There is a series of contiguous unidirectional step fractures within the concavity.

CORE TOOL

A single complete core tool consists of a

Table 7.15. Biface types by completeness, Area 3, 41CV595

Completeness	Early- to middle-stage	Late-stage to finished	Total
Proximal fragment	1	1	2
Distal fragment	2	1	3
Edge fragment	4	1	5
Indeterminate	4	1	5
Total	11	4	15

Figure 7.31. Ensor dart points, Area 3, 41CV595

multidirectional core that retains abraded cortex (see Figure 7.32). It shows battering damage along multiple edges, suggesting heavy impact use (e.g., chopping).

EDGE-MODIFIED FLAKES

Almost one-third of the tools in the chipped stone assemblage consist of edge-modified flakes. The 16 artifacts comprise 8 complete and 1 nearly complete specimen, as well as 2 proximal, 1 medial, and 4 distal fragments.

CORES

Two complete cores are multidirectional flake cores discarded at or near exhaustion (see Figure 7.32). Both retain less than 50 percent cortex and show no heat treatment.

UNMODIFIED DEBITAGE

Just more than 60 percent (687 of 1,140) of the unmodified debitage was recovered from feature contexts, especially Feature 3, which produced 53 percent of all the unmodified flakes. A total of 372 (32.6 percent) complete specimens were recovered, along with 167 proximal fragments (14.7 percent), 593 chips (52 percent), and 8 chunks (0.7 percent). Most of the flakes (87.7 percent) lack cortex (Table 7.16). Only 22.5 percent (n = 257) of the unmodified flakes could be identified to named chert types, with Fort Hood Yellow and Fossiliferous Pale Brown being the dominant types (n = 154, 59.9 percent).

Burned Rocks

The excavations in Area 3 produced 3,482.95 kg of burned rocks. Although four features account for 96.6 percent of this total, the burned rock mound makes up 87.3 percent of the entire weight. Again, the overwhelming number of burned rocks consists of fossiliferous limestone that outcrops nearby.

Faunal Remains

One intrusive armadillo ulna was recovered just above the top of Feature 3 in Test

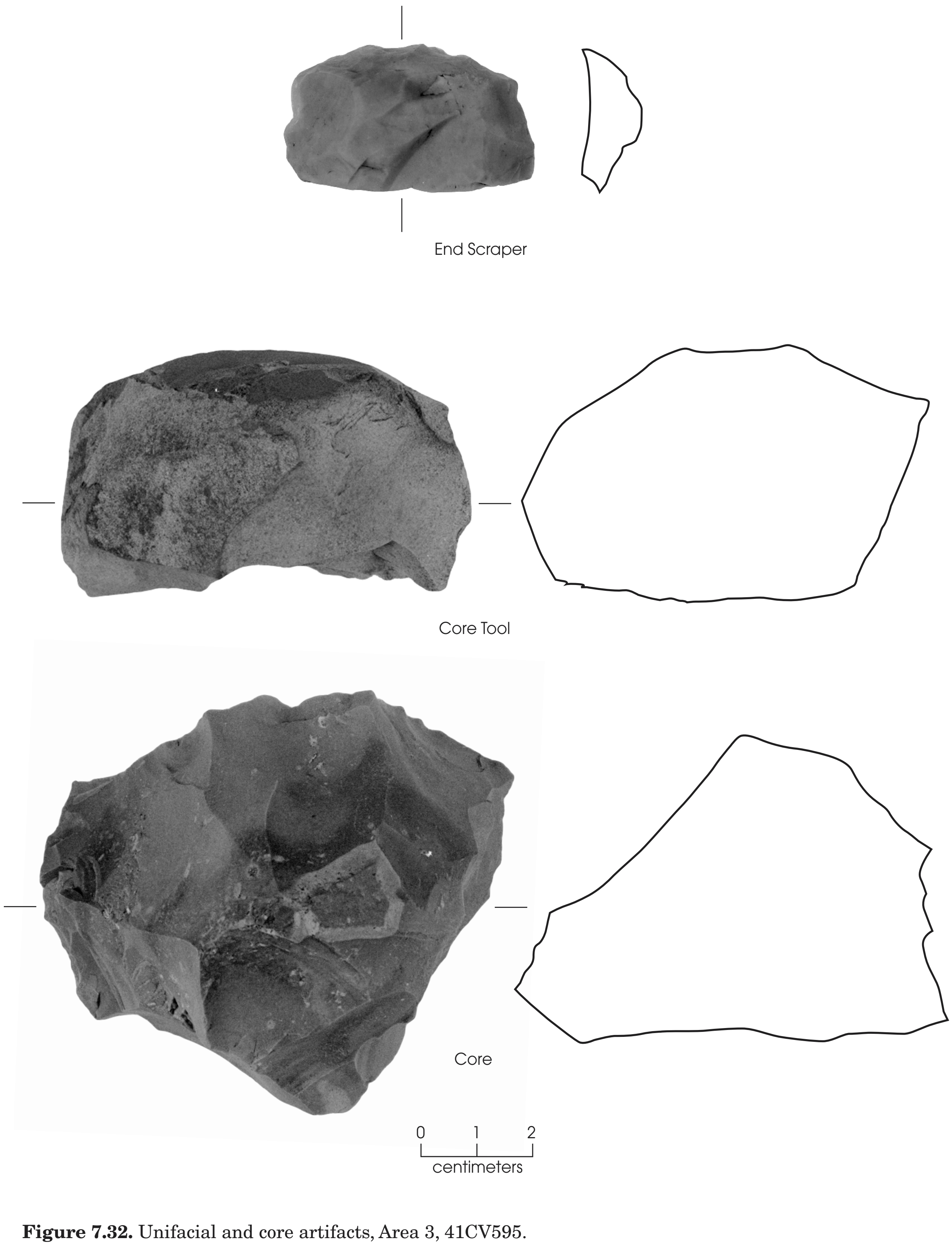

Figure 7.32. Unifacial and core artifacts, Area 3, 41CV595.

Table 7.16. Summary of unmodified debitage by chert type and cortex percentage, Area 3, 41CV595

Chert Type	Cortex 0%	1–50%	50–99%	100%	Total
Anderson Mountain Gray	7	–	–	–	7
Cowhouse Dark Gray	13	–	1	–	14
Cowhouse Mottled with Flecks	–	1	–	–	1
Cowhouse Novaculite	–	1	–	–	1
Cowhouse Two Tone	10	1	1	–	12
Cowhouse White	8	1	–	–	9
Fort Hood Gray	2	–	–	–	2
Fort Hood Yellow	72	10	1	–	83
Fossiliferous Pale Brown	10	–	–	–	10
Gray-Brown-Green	64	7	–	–	71
Heiner Lake Blue	6	2	–	–	8
Heiner Lake Blue - Light	19	1	–	–	20
Heiner Lake Translucent Brown	14	2	–	–	16
Owl Creek Black	2	1	–	–	3
Subtotal	227	27	3	0	257
Indeterminate chert types	773	88	17	5	883
Total	1,000	115	20	5	1,140

Unit 57. The only other faunal materials are composed of one burned and one unburned bone fragment and one mussel shell. Features 3 and 4 contain these three specimens, which are all unmodified and unidentifiable.

Macrobotanical Remains

Twenty-two flotation samples were col-lec-ted from feature deposits, but only 8 samples from Features 3 and 4 produced charred wood (see Appendix B). Two flotation samples recovered from nonfeature contexts were sterile.

SUMMARY AND ASSESSMENTS

Excavations by Prewitt and Associates in 2000 reveal that the Firebreak Site contains intact buried archeological remains. A detailed analysis and interpretation of these remains is presented in Chapter 8. These excavations constitute a partial data recovery, effectively mitigating some of the unintentional damage from the 1996 firebreak blading. The work also revealed that a substantial amount of buried archeological material remains intact, and it is recommended that 41CV595 is still eligible for listing in the National Register of Historic Places (see Chapter 9).

ANALYSIS AND INTERPRETATIONS OF CULTURAL OCCUPATIONS AT THE FIREBREAK SITE

Douglas K. Boyd, Christopher W. Ringstaff, and Gemma Mehalchick

8

This chapter examines geoarcheological data from the Firebreak site to address specific research issues. It is organized using the same six topical headings as the site-specific Paluxy research questions presented in Chapter 3. The first section of this chapter—Chronology—summarizes the absolute and relative chronological evidence (namely projectile points and radiocarbon dates) to interpret when the sandy sediments and cultural remains were deposited at the Firebreak site. The second section—Site Formation—looks at what has happened to the sediments and cultural remains since they were deposited. The vertical and horizontal distributions of artifacts and features are analyzed within each of the three main excavation areas to determine the geomorphic context of the natural deposits, the intensity and duration of human occupations, and the degree to which individual components or occupation episodes may be recognized. The third section of the chapter is devoted to examining Lithic Production and Reduction Strategies, and topics considered include acquisition of raw materials, heat treatment, lithic technology, and functional interpretations. In the fourth section—Subsistence Technologies and Resources—interpretations are offered about the foods that the Firebreak inhabitants ate, as well as their techniques for processing them. Site Function and Seasonal Occupation, the fifth section, is an overview of interpretations of the human activities that occurred at Firebreak and at what time(s) of year the occupations occurred. The sixth section examines the Firebreak site data that pertain to Paleoenvironmental Research. The seventh and final section summarizes the interpretations by addressing the research questions that were proposed in Chapter 3.

As described in this chapter, the investigations at the Firebreak site produced data that support some interesting interpretations of Late Archaic and Late Prehistoric hunter-gatherer adaptations to the landscape and resources of central Texas. Particularly important are the data on burned rock features at Paluxy sites and the observations and interpretations of the use of cooking pits—aka earth ovens—within the context of burned rock middens and mounds. Within this chapter, as in previous studies on Fort Hood (e.g., Abbott and Trierweiler 1995a:771–775; Kleinbach et al. 1999:411–417; Trierweiler ed. 1994), burned rock middens are distinguished from burned rock mounds. Middens are large irregular accumulations of burned rocks that may contain multiple earth ovens, other internal features, and dumps of burned rocks from other activities (e.g., stone boiling). Mounds, however, are isolated accumulations that have a domed shape (occasionally with a central depression) and are thought to have formed from repeated use of a single, centrally located earth oven.

CHRONOLOGY

Thirty-three diagnostic projectile points (Table 8.1) provide relative dating of the cultural occupations at the Firebreak site ranging from 1250 B.C. to 1550 A.D. The 14 calibrated radiocarbon dates from feature and non-feature contexts (see Table 7.6) span just more than 2,000 years, from approximately 790 B.C. to A.D. 1263. The fifteenth date of A.D. 1670–1950 on charcoal from nonfeature sediments is not considered because it probably represents a modern intrusion. Both the relative and absolute chronological data indicate repeated occupations beginning near the

Table 8.1. Summary and chronology of projectile points from all phases of work, 41CV595

Point Type	No. of Points Recovered				Beginning Date	Ending Date	Reference
	General Surface	Area 2	Area 3	Total			
DART POINTS							
Pedernales *	2	–	–	2	1250 B.C.	500 B.C.	Collins 1995
Marshall	–	1	1	2	500 B.C.	200 B.C.	Collins 1995
Castroville	1	1	–	2	200 B.C.	A.D. 150	Collins 1995
Montell	–	1	–	1	200 B.C.	A.D. 150	Collins 1995
Ellis	2	–	–	2	A.D. 200	A.D. 700	Elton Prewitt, personal communication 2000
Ensor	2	4	6	12	A.D. 200	A.D. 550	Collins 1995
Darl	2	4	2	8	A.D. 550	A.D. 750	Collins 1995
Preform	1	–	1	2	–	–	–
Untyped	2	2	1	5	–	–	–
Untypeable	–	6	1	7	–	–	–
Subtotal	12	19	12	43			
ARROW POINTS							
Scallorn	–	1	–	1	A.D. 750	A.D. 1150	Collins 1995
Alba	–	–	2	2	A.D. 800	A.D. 1200	Turner and Hester 1999
Perdiz	–	–	1	1	A.D. 1150	A.D. 1550	Collins 1995
Preform	–	1	–	1	–	–	–
Untypeable	–	–	1**	1	–	–	–
Subtotal	0	2	4	6			
Total	12	21	16	49			

Note: Includes 10 points collected by Texas A&M University, 7 points collected by TRC Mariah Associates, and 31 points collected by Prewitt and Associates.

*One Pedernales point is misidentified as a Marshall in the site report (Abbott and Trierweiler, eds. 1995:479) but is correctly identified as a Pedernales in the microfiche artifact database (Abbott and Trierweiler, eds. 1995:Appendix C).

**This untypeable specimen refits with the Perdiz point.

middle of the Late Archaic period, possibly as early as 1250 B.C., and continuing through the Late Prehistoric period, including both the Austin and Toyah phases (Figure 8.1).

In two cases, intermixing of the deposits by human activities or natural processes is clearly evident. One is the stratigraphic reversal of two dated charcoal samples from different depths (Levels 3 and 6) in the burned rock midden (Feature 1) in Area 1 (Abbott and Trierweiler, eds. 1995a:476). The other is the presence of two arrow point fragments from different contexts within Area 3 that refit into a single complete Perdiz point. In other cases, such as the cooccurrence of a Castroville dart point and a Scallorn arrow point in Feature 2 (at 20–30 cm in Test Pit 3; Abbott and Trierweiler eds. 1995a:478), it is unclear if later people reused older artifacts or repeated cooking activities jumbled the midden deposits.

The strongest evidence for reuse–or perhaps more precisely repeated use–of the middens, mounds, and earth ovens at Firebreak is the three divergent radiocarbon dates obtained on charcoal samples from different parts of earth oven Feature 11. The three dates on Feature 11 (2140 ± 40 B.P.; 2050 ± 40 B.P.; and 1580 ± 40 B.P.) are considered statistically different at a 95 percent level of confidence (Stuiver and Reimer 1993). The earlier two dates, from charcoal samples in the center and near the west edge of the pit feature, are statistically the same and may be averaged as 2094 ± 40 B.P., which calibrates to 340 B.C. to A.D. 1 (2-sigma). The third date, however, is statistically different and most likely represents later use of the earth oven at A.D 230–660. Thus, these data indicate two separate use episodes that occurred perhaps 550 years apart (at least 284 years apart and possibly as much as 826 years apart). The gap between these two apparent episodes is not necessarily real, and Feature 11 could have been reused intermittently throughout this interval. In fact, it seems reasonable to suggest that this rock-lined earth oven was used on several different occasions, perhaps many different times over a span of several hundred years, but that much of the evidence for other use episodes (i.e., datable samples from other periods) was destroyed each time the pit was thoroughly cleaned out and re-lined.

The radiocarbon and projectile point data hint at the spatial patterns of occupation at the Firebreak site. The vertical separation of occupations is extremely tenuous because cultural materials from different periods may occur at similar depths and some deeper buried features and activities appear to postdate those at higher elevations. These problems reflect spatially concentrated, repeated human activities over a long period on a fairly stable surface in a slow but dynamic depositional environment that was subject to serious postdepositional disturbances. Bearing this in mind, the radiocarbon assays and material culture appear to indicate little or no vertical separation of components but a greater degree of horizontal separation of human activities over time. The spatial distributions of artifacts and features are considered in more detail later, but a brief history of cultural occupations at the Firebreak site may be offered based solely on the chronological evidence.

The earliest occupations at the Firebreak site occurred in Area 3. A charcoal date of 790–430 B.C. from an earth oven (Feature 4) indicates that the burned rock mound (Feature 3) began to accumulate at this time, during the middle of the Late Archaic period. Diagnostic projectile points from Area 3 indicate that the mound probably continued to accrete, perhaps sporadically, into the Toyah phase. Two refit Perdiz arrow point fragments were found, one in the upper portion of the mound deposits, and the other above the mound deposits. They probably represent some of the latest use episodes in Area 3.

Area 2 activities began during the latter half of the Late Archaic period. Two adjacent earth ovens (Features 11 and 15) appear to have been used simultaneously and may represent the beginning of the burned rock midden accumulation (Feature 2) in this area between 360 B.C. and A.D 660. Later activities, represented by an earth oven (Feature 8) and two hearths (Features 12 and 14), denote continuity in the periodic use of Area 2 from A.D 650 to 1020, during the transition from Late Archaic into the Austin phase. Diagnostic projectile points from Area 2 indicate continual, if sporadic, occupations over the entire time, and they correspond well with the radiocarbon evidence.

Area 1 occupations appear to be relatively late. Radiocarbon dates from the burned rock midden (Feature 1) and a hearth (Feature 6) indicate activities between A.D. 661 and 1263, during the terminal Late Archaic and throughout the Austin phase of the Late Prehistoric

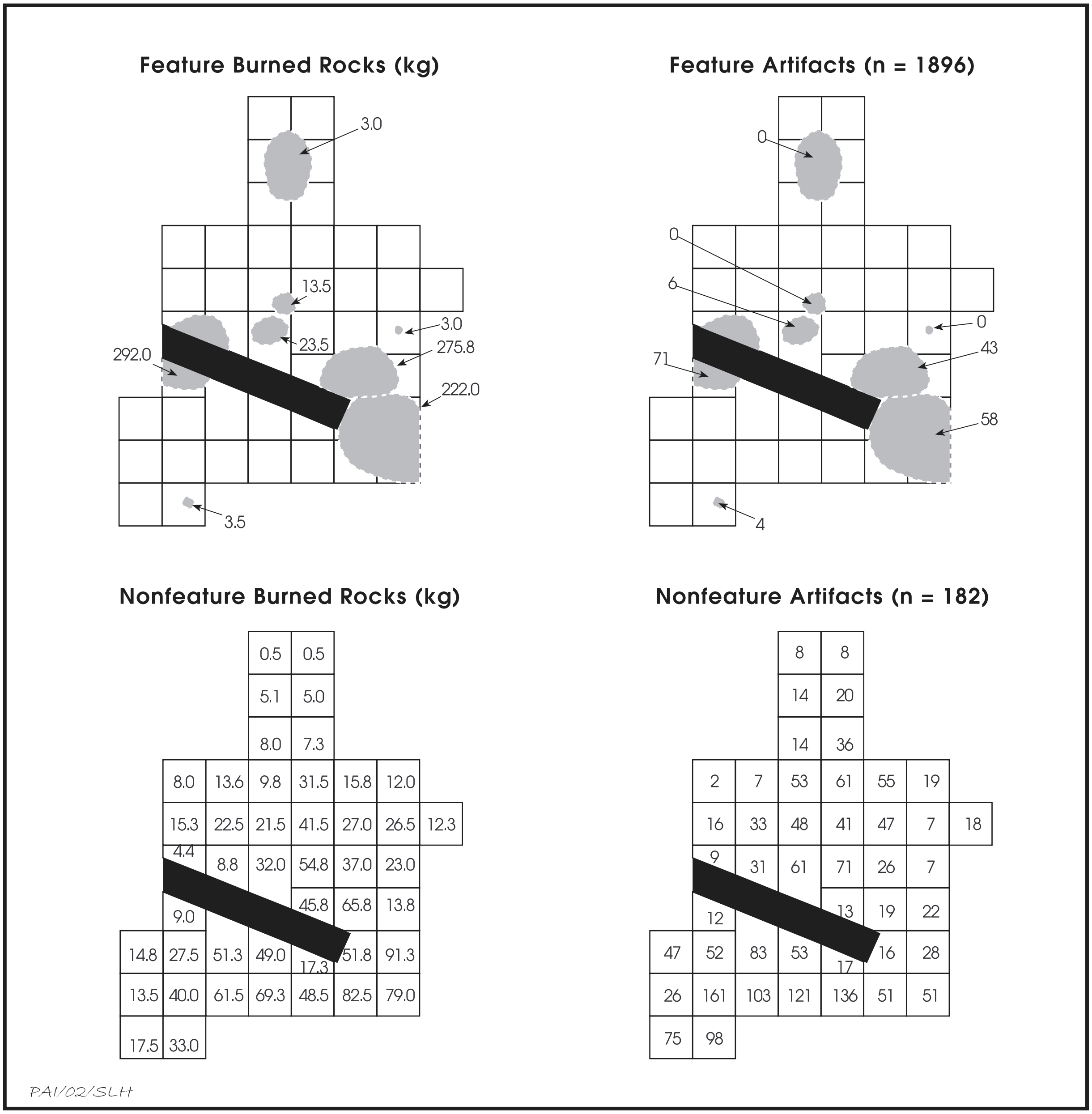

Figure 8.1. Chronology of cultural occupations at 41CV595 based on calibrated (1-sigma range) radiocarbon dates and typed projectile points. Data are from Tables 7.6 and 8.1.

period. No projectile points were found in the limited excavations in Area 1.

SITE FORMATION AND SPATIAL ANALYSES OF FEATURES AND MATERIAL CULTURE

Horizontal and vertical distributions of stone artifacts and features at 41CV595 were examined to identify how and when the cultural materials were deposited and whether there are distinct cultural components or meaningful spatial patterns within each excavation area. The spatial distribution of artifacts and features is the product of a combination of prehistoric human activities, geological site formation (e.g., slopewash), and natural and human postdepositional processes (e.g., bioturbation and mechanical disturbances). These forces are difficult to understand individually, and they can interact in complex ways in different settings.

Spatial analyses were considered an important step toward understanding the human and natural activities that created the Firebreak site.

Comparing overall artifact and burned rock densities for the three excavation areas at the Firebreak site indicates that certain cultural activities were intensive in Areas 2 and 3 and less intensive in Area 1 (Table 8.2). Artifact frequencies were about two times greater in Areas 2 and 3, and the burned rock densities were two and a half to seven times greater in Areas 2 and 3. Remembering that some portion of the upper burned rock midden (Feature 2) deposits in Area 2 were bladed away and that the previous Test Pits 2 and 3 were on the outer edges of the midden, the burned rock density of 105.5 kg per m^3 may be misleading. If the upper midden deposits had been sampled all across the excavation block, it is likely that the burned rock density for Area 2 would have been higher. Nonetheless, the abundance of burned rocks in Areas 2 and 3 denotes intensive heating and cooking activities.

Artifact distributions within each area were analyzed by examining the frequency of all stone artifacts and the frequencies of selected types of artifacts (i.e., projectile points, chipped stone tools, and debitage). Vertical distributions were done by plotting artifact frequencies within each level in cross sections representing selected transects across excavation areas or by combining several units into a single vertical profile. Horizontal distributions were done by plotting artifact frequencies within each unit on plan maps of each area.

Area 1

Previous investigations in Area 1 discovered an extensive 100-cm-thick burned rock midden (Feature 1). It was most obvious in Test Pit 1 because of the density of burned rocks. Although the data recovery excavations were in the area where Feature 1 was mapped in 1993 and Backhoe Trench 6 crosscut the old backhoe trench and test pit (see Figure 7.5), no surface evidence of the midden was observed in 2000, and no dense accumulations of burned rocks or anthropogenic deposits were encountered in the excavations.

These results suggest that Feature 1 is more restricted horizontally than originally thought. The data recovery test units appear to be just west of the midden feature. Interestingly, the cultural deposits exposed in Test Units 5–7 are about 110 cm thick, which is approximately the same thickness as the midden deposits observed in Test Pit 1. This similarity suggests that this area was damaged only minimally, if at all, during the 1996 firebreak clearing activity.

Calibrated charcoal radiocarbon dates (2-sigma range) of A.D. 661–959 and A.D. 990–1263 for Feature 1 and A.D. 1000–1170 for Feature 6 indicate repeated occupation primarily during the Late Prehistoric period, Austin phase (see Table 7.6). The two Feature 1 dates are stratigraphically reversed (Abbott and Trierweiler, eds. 1995a:476), reflecting cultural disturbances from reuse of the feature (e.g., jumbling of deposits caused by digging new cooking pits), postdepositional disturbances (e.g., bioturbation by tree roots and burrowing animals), or some degree of both. Stratigraphic reversal of artifacts and datable materials is a common phenomenon in prehistoric burned rock middens and is most commonly attributed to activities of prehistoric peoples (e.g., Leach and Bousman 1998).

Nine of the 10 levels excavated from the midden in 1993 yielded sparse artifacts (see Test Pit 1 in Table 7.1), but an obvious peak in debitage density along with an increase in burned rock frequency occurs at the base of the feature, from 100 to 110 cm below surface. In the bottom level of the midden, just more than half of the flakes are small (i.e., 0.5 to 1.2 cm), and no apparent disturbance was noted to suggest postdepositional transportation of small artifacts. Six bones recovered from the midden consist of canid- to deer-sized mammals, and four are spirally fractured.

Consisting of only three contiguous test units, the Area 1 data recovery sample of material culture is so small that horizontal distributions of material remains are not particularly informative, and all three units yielded a similar number of stone artifacts (see Table 7.7). The vertical distribution of cultural materials is interesting and helps characterize the archeological deposits in this portion of the site.

When the cultural remains from all three data recovery units are collapsed into a single vertical column, it shows that 69.2 percent (81 of 117) of the artifacts occurred at 98.70–98.30 m, some 20 to 60 cm above the top of Feature 6. In contrast, the burned rocks are

Table 8.2. Comparison of artifact and burned rock densities by area, 41CV595

Excavation Area	Investigation	Volume of Hand-Excavated Sediments (m^3)	Total Artifacts	Artifact Density (no. per m^3)	Total Burned Rocks (kg)	Burned Rock Density (kg per m^3)
AREA 1	Mariah Associates, 1993	1.60	113	70.6	113.9	71.2
	Prewitt and Associates, 2000	3.20	123	38.4	82.2	25.7
Subtotal		4.80	236	109.0	196.1	40.9
AREA 2	Mariah Associates, 1993	1.60	318	49.2	73.8	46.1
	Prewitt and Associates, 2000	20.49	2,078	101.4	2,162.2	105.5
Subtotal		22.09	2,396	108.5	2,236.0	101.2
AREA 3	Prewitt and Associates, 2000	11.98	1,193	99.6	3,483.2	290.8
Total		38.87	3,825	98.4	5,915.3	152.2

Note: Volume excludes hand-excavated sediments that were obviously disturbed and not screened.

concentrated 10 to 30 cm lower, from 98.20 to 98.00 m, and include Feature 6 (Table 8.3).

Comparing the cultural materials (cf. Tables 7.1 and 8.3) shows a marked difference between the burned rock densities of the midden deposits in 1993 Test Pit 1 (453 burned rocks per m^3) and the nonmidden deposits in the three data recovery units—Test Units 5–7 (60 burned rocks per m^3). The number of burned rocks is about 7.5 times greater in the midden than in the nonmidden deposits. Although less so, the density of burned rocks by weight also differs, with burned rocks being about 3.8 times denser in the midden (104.3 kg per m^3 in Test Pit 1) than in the general level contexts (27.4 kg per m^3 in Test Units 5–7). The relatively high number vs. low rock weight means the midden is composed of lots of small burned rock fragments, which may indicate multiple use episodes because rocks tend to break down further with repeated heatings. This assessment agrees with the interpretation of jumbled midden deposits and helps explain the stratigraphically reversed radiocarbon dates from the midden.

The conclusions that must be drawn from the distributional analysis are that the cultural remains in Area 1 were deposited in a deep gully but are limited in horizontal extent by the tank trail and erosion immediately to the north. The current sample of cultural remains from Area 1 must be treated as single analysis unit, despite the fact that the occupations may represent as much as 600 years. The lithic artifact sample is very small, and there is no way to separate these materials into more discrete units or components. Because the depth of the deposits is greater than one meter, some degree of gross vertical separation of materials might be possible if a larger sample were obtained from this area.

Area 2

In the vicinity of Area 2, the 1993 testing results encountered a 70-cm-thick burned rock midden (Feature 2) in Backhoe Trench 2 and Test Units 2 and 3. Test Units 18 and 19 abut the previously excavated trench that exposed the feature, and the combined mapping data indicate that most of the current Area 2 excavation

Table 8.3. Vertical distribution of cultural materials, Area 1, 41CV595 (Test Units 5–7 combined)

	Artifacts						Faunal Remains		Burned Rocks	
Elevation (m)	Edge-modified flakes	Cores-tested cobbles	Unmodified debitage	Hammerstone	Metate	Artifact total	Unmodified bones	Unmodified mussel shells	Count	Weight (kg)
Backhoe Trench 6, backdirt (unknown depth)	–	–	–	–	–	1	–	–	–	–
98.86–98.80	–	–	–	–	–	–	–	–	2	0.25
98.80–98.70	1	–	8	–	–	9	–	–	15	1.75
98.70–98.60	1	–	21	–	–	22	–	–	27	8.00
98.60–98.50	–	–	33	–	–	33	–	2	39	7.50
98.50–98.40	1	1	14	–	–	16	–	–	25	6.00
98.40–98.30	–	2	8	–	–	10	–	–	23	5.00
98.30–98.20	–	1	6	–	–	7	–	–	11	4.50
98.20–98.10	–	–	8	–	–	8	3	–	12	26.50
98.10–98.00	–	–	5	1	1	7	–	–	5	2.50
Feature 6 (98.10–97.99)	–	–	5	–	–	5	3	–	20	20.00
98.00–97.90	–	–	2	–	–	2	–	–	1	0.10
97.90–97.80	–	–	1	–	–	1	–	–	1	0.10
97.80–97.70	–	–	3	–	–	3	–	–	–	–
98.70–98.60	–	–	–	–	–	–	–	–	–	–
Total	3	4	114	1	1	123	6	2	181	82.20

block subsumed Feature 2 (see Figure 7.5). Damage from the firebreak activity is quite apparent in Area 2, and obviously disturbed sediments in the excavations reflect clearing and stripping of the area. The actual amount of sediment that firebreak blading removed is unknown, but up to 50 cm of fill may have been stripped off of Area 2. The data recovery encountered the greatest quantities of burned rocks in the southeastern two-thirds of the block, and this concentration appears to correspond with the lower portion of Feature 2.

Multiple overlapping, calibrated (2-sigma) radiocarbon dates span the Late Archaic and Late Prehistoric periods from 360 B.C. to A.D. 860, with one slightly later assay occurring at A.D. 880–1020. The diagnostic dart and arrow points also support this chronology (see Figure 8.1).

The burned rock features comprise three earth ovens, each measuring more than 150 cm in diameter, two concentrations, one hearth, and one small cooking pit. Each large oven is basin-shaped, contains high rock counts and weights, and consists of dark, organic-rich sediment that contains charred macrobotanical remains. These three pits are the only features yielding remains of edible plants. The fill from each feature produced a comparable stone assemblage that debitage and edge-modified flakes dominated. Two pits also yielded four of the six bones recovered from the excavation block. In contrast, one hearth possibly representing some sort of open-air cooking feature has a flat base (Ellis 1997:Figures 9–15), contains no organic-stained fill, and yielded few identifiable wood types. The remaining two concentrations and one small pit are discrete and probably associated with different subsistence activities other than the extended cooking done in earth ovens (Wandsnider 1997). Finally, one feature consisting primarily of unburned rocks may represent a cache of unmodified rocks intended for later use, or perhaps remnants of an ephemeral structure or house.

The previously sampled midden deposit and the Area 2 excavation block produced similar artifact assemblages, but faunal remains were far more common in the midden than in the excavation block. The two midden units yielded the same amount of faunal remains (including cottontail rabbit and canid- to deer-sized bones) as did all 45 contiguous test units making up the excavation block. Formal and expedient stone tools are present, with expedient tools making up at least one-third of the assemblage. The paucity of cores in contrast to the ubiquity of noncortical debitage suggests that the chert knapping that occurred on site was primarily late-stage lithic reduction. Pitted stones and metates indicate food resources requiring other types of processing as well as, or aside from, cooking.

The horizontal frequency distribution of all stone artifacts in Area 2 shows seven contiguous units in the southwest and south central portion of the block producing the greatest density, with more than 75 artifacts per unit (Figure 8.2). Three of these excavations (Test Units 39, 46, and 47) also contain high burned rock weights. Thus, there is a general pattern apparent, with the units yielding high artifact counts clustered south and west of the large cooking pits.

Schematic and collapsed cross sections of the vertical distributions of lithic artifacts and burned rocks (Figures 8.3 and 8.4) display two notable patterns. The levels with the highest artifact frequency are shallower on the west and north but become slightly deeper to the east and south across the excavation area. The maximum vertical range of lithic artifacts also increases from west to east and north to south, indicating that the cultural deposits may be more compressed in the western and northern portions of the block. Although Area 2 seems to be centrally located within the Paluxy deposits at Firebreak, a uniform thickness of culture-bearing (Stratum I) deposits should not be expected. The vertical artifact distribution indicates that the underlying sediments (Stratum II) were incised and undulating before being buried.

Arrow and Dart Points

A single arrow point preform was recovered from the eastern margin of Area 2 in an area of relatively low artifact frequency. The vertical provenience of the arrow point (99.40–99.30 m) is the same as one Late Archaic dart point (Ensor) and two untypeable dart points from Area 2 (see Figure 8.4), suggesting either a palimpsest of cultural materials on a stable surface or post-depositional mixing of different temporal assemblages by pedogenic or biological means.

The horizontal distribution of 15 dart points recovered from Area 2 (see Figure 8.4) reveals

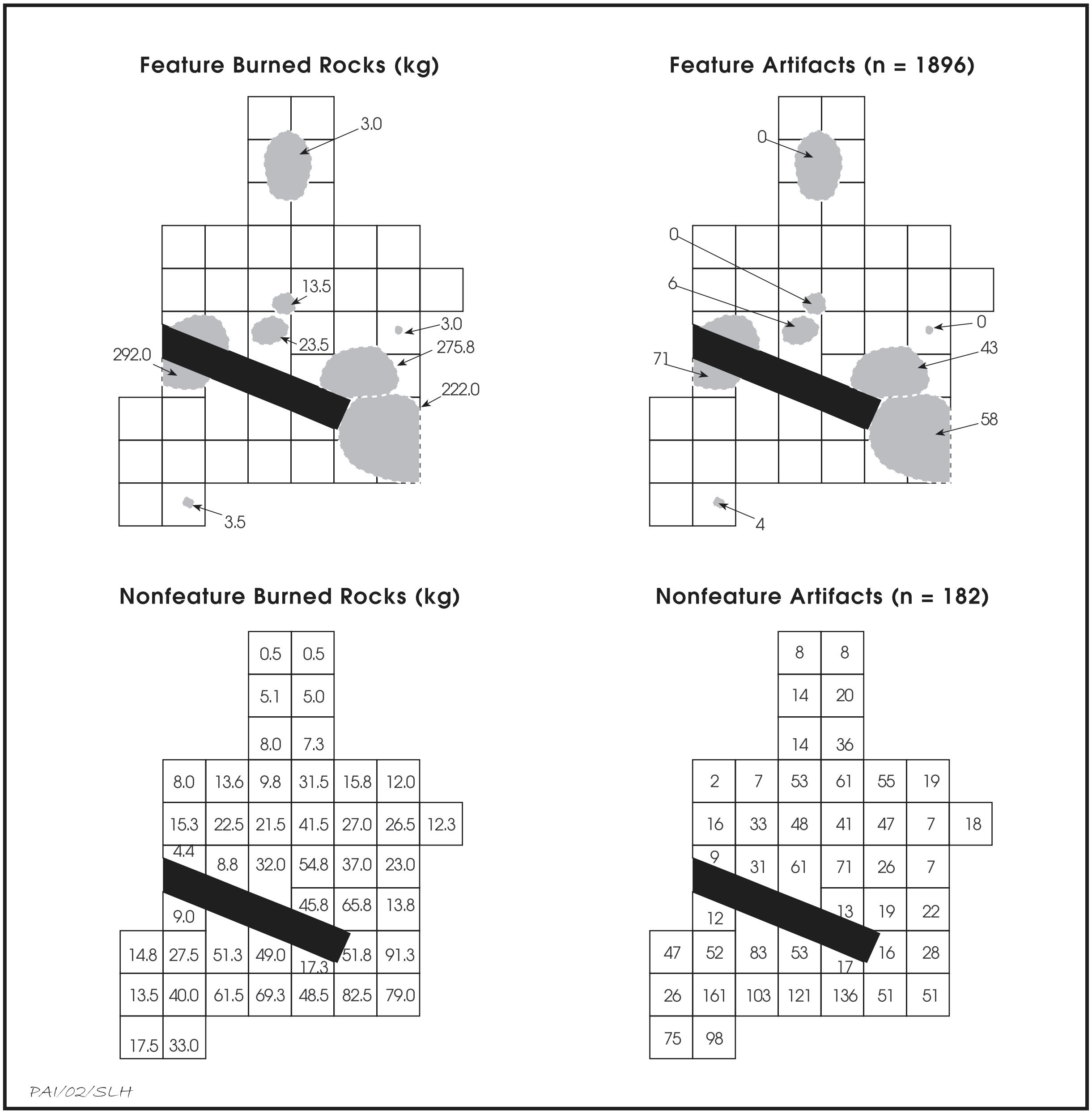

Figure 8.2. Horizontal distributions of stone artifacts and burned rocks from feature and general level contexts in Area 2, 41CV595.

several notable patterns. Three of the four Darl points were in the southern portion of the excavation area where the overall frequency of lithic artifacts is the greatest. Of the four Ensor points found, two were recovered from the southeastern corner of Area 2 in association with Feature 15, one was found near Feature 12, and the remaining specimen was recovered from the northern portion of the area. A cluster of four untypeable dart point fragments was recovered from the south central portion of Area 2. Two untypeable fragments found one meter north of the cluster are close to Feature 12.

The vertical distribution of dart points from Area 2 reveals two patterns. The dart points range in elevation from 99.70 to 99.10 m, with 11 specimens (73.3 percent) occurring between 99.50 and 99.20 m (see Figure 8.4). And the dart points of different age do not appear to have meaningful vertical segregation, with the older Marshall point falling squarely among the later Darl and Ensor points. These observations also

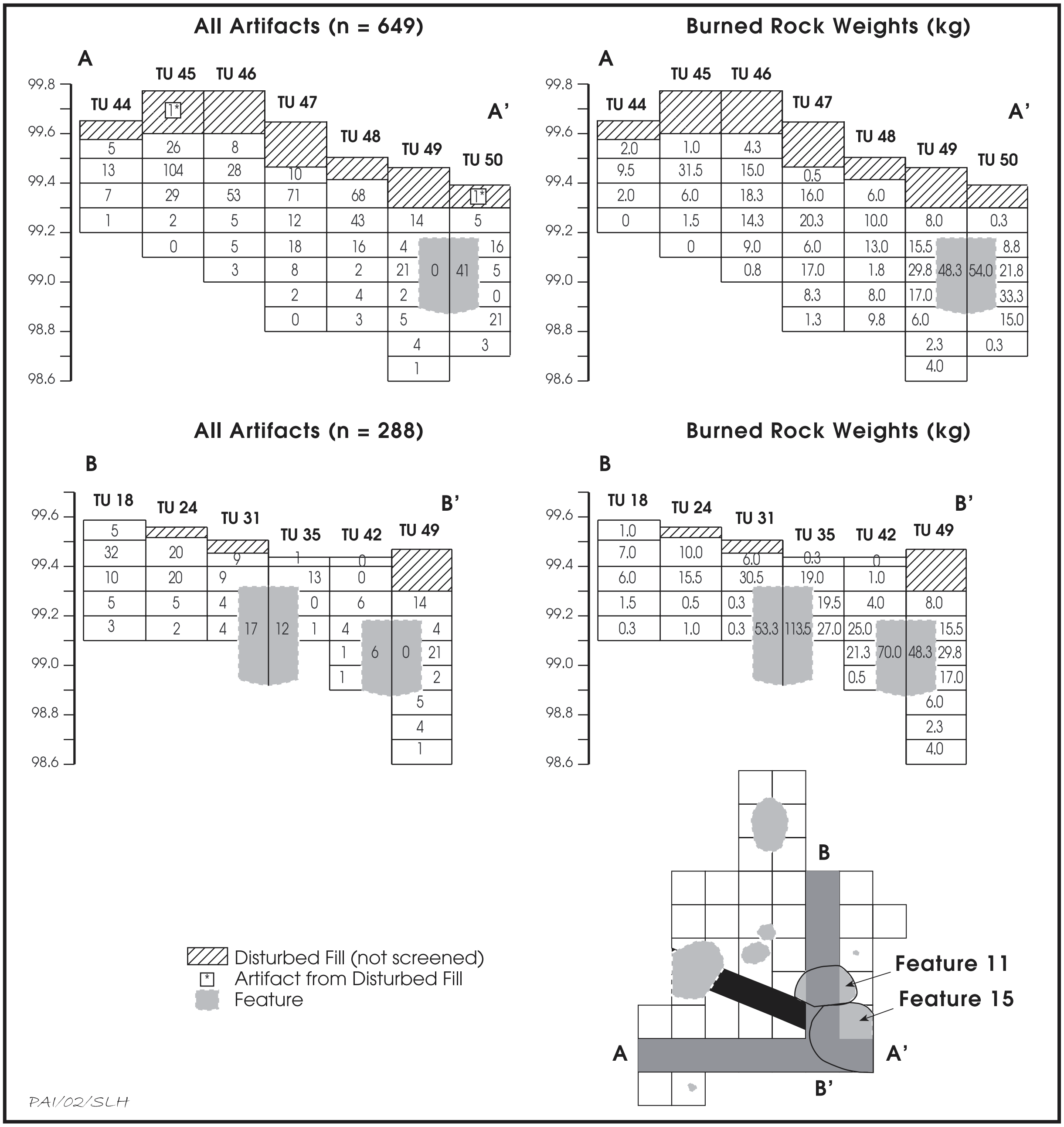

Figure 8.3. Schematic cross sections showing the vertical distributions of all lithic artifacts and burned rocks in Area 2, 41CV595. Elevations are in meters.

suggest a palimpsest deposit or postdepositional mixing of sediments.

Other Lithic Tools

The horizontal distributions of the 60 non-projectile point lithic tools recovered from Area 2 are presented by artifact class in Figure 8.5. These lithic tools exhibit relatively even, perhaps random, distributions with a few anomalies that warrant mention. There are clusters of bifaces in Test Units 31 and 49. Edge-modified flakes are more common in the northern half of the excavation block and are clustered in Test Unit 13 and in Test Units 27, 28, and 29. Unifaces and cores occur with greater frequency in the southern portion of the excavation block, where total lithic artifact frequencies are also highest. Ground stone artifacts are sparse, and the only usable tools are a complete metate found in Test

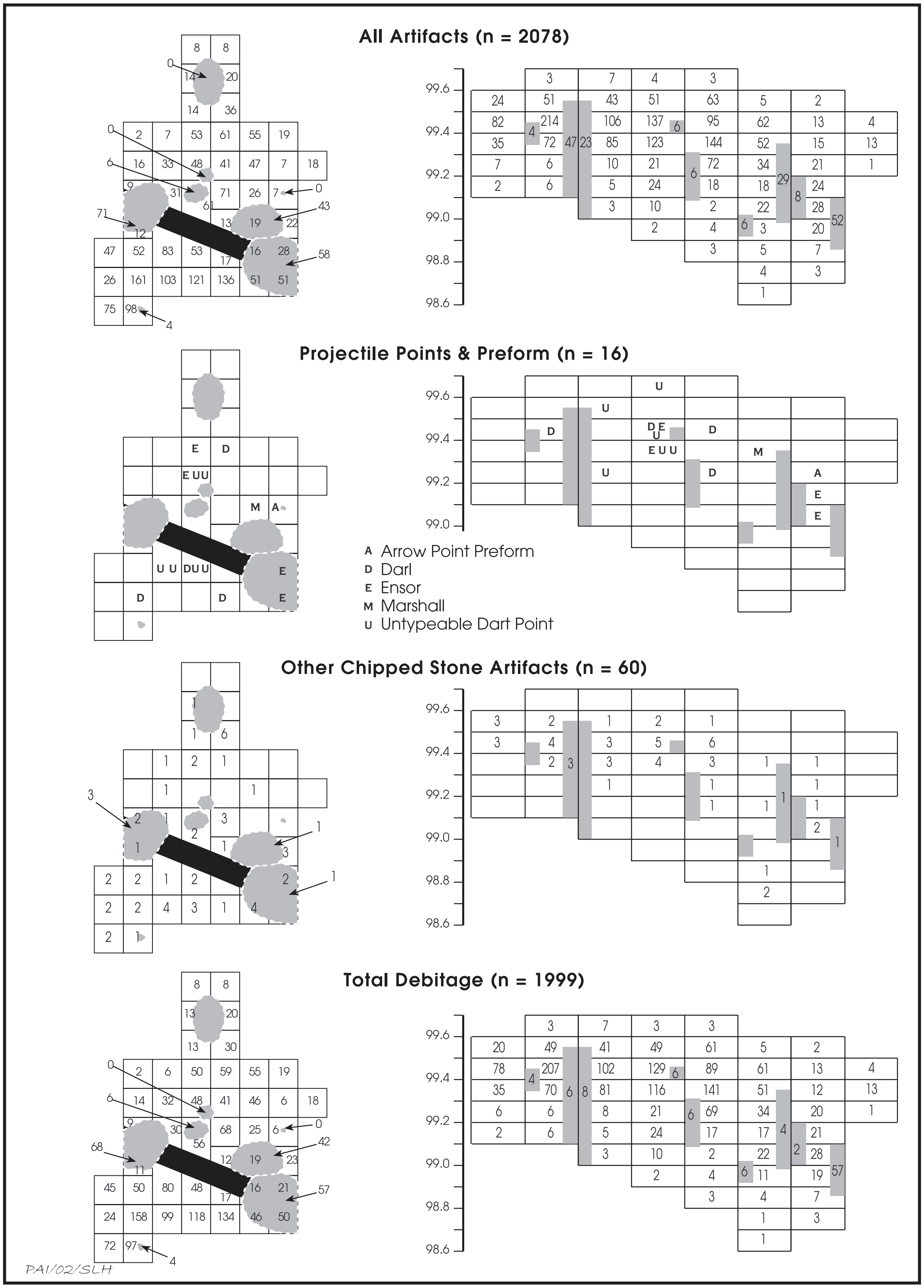

Figure 8.4. Horizontal and vertical distributions (collapsed west-to-east cross sections) of all artifacts from feature and nonfeature contexts in Area 2, 41CV595. Elevations are in meters.

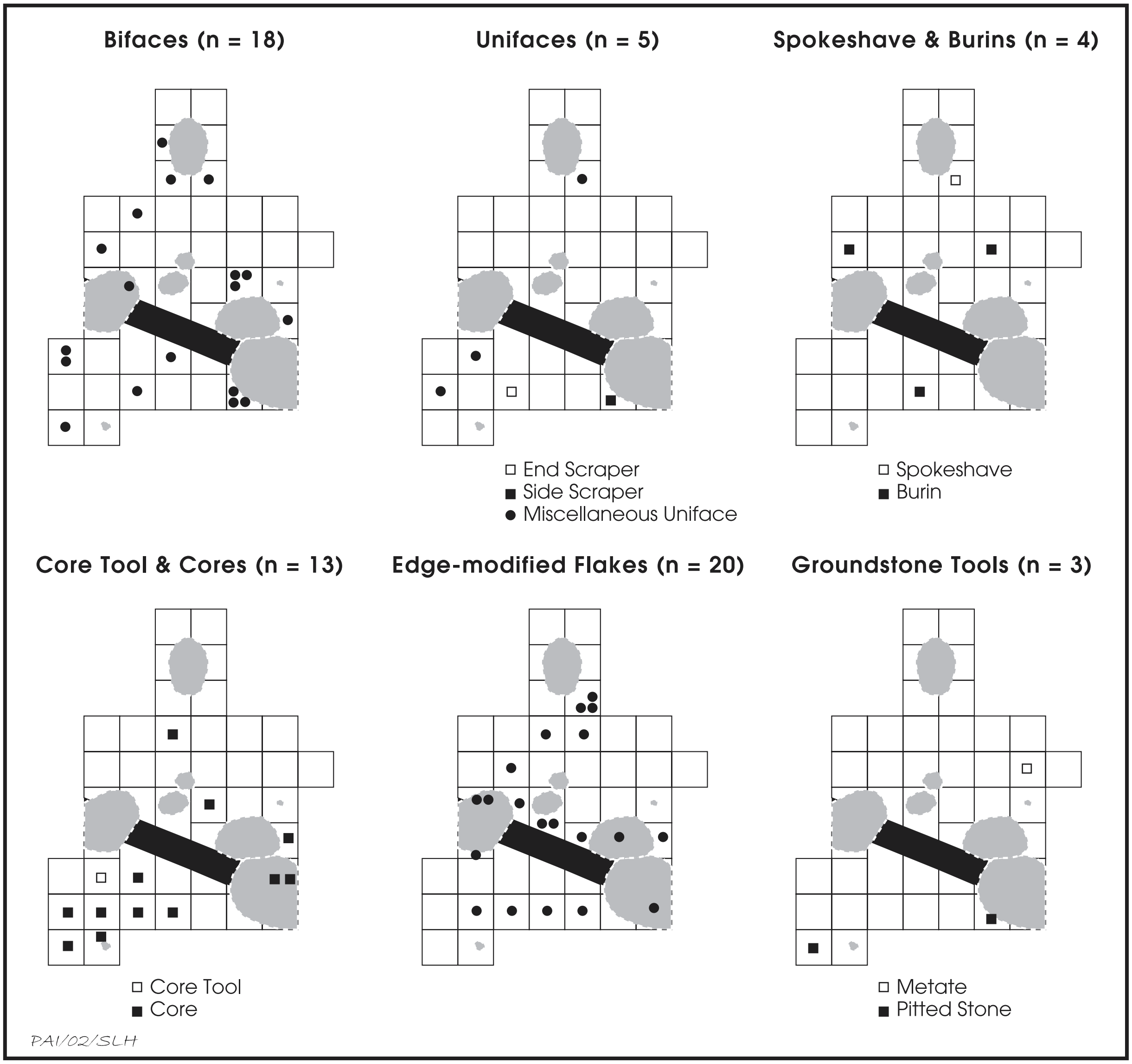

Figure 8.5. Horizontal distributions of various classes of lithic tools, Area 2, 41CV595.

Unit 25 within an area notably devoid of other tools and a complete pitted stone found in Test Unit 49.

The vertical distribution of non-projectile point lithic tools (see Figure 8.4) shows two notable patterns when compared with the vertical distribution of total lithic artifacts. The vertical range of lithic tools is more limited than the vertical range of all lithic artifacts, and the vertical range of lithic tools increases from west to east across Area 2. These observations may suggest that the culture-bearing deposits are thicker downslope to the east or that more of the cultural deposits were stripped away from the upslope portion of Area 2. Also, following the same vertical distribution pattern seen for all lithic artifacts, there is a slight increase in the maximum depth of lithic tools from west to east across the excavation area. This increase suggests that the ancient surface(s) on which the Area 2 cultural materials were deposited sloped eastward toward Stampede Creek, approximating the modern slope in direction and dip.

Debitage

The horizontal distribution of total debitage in Area 2 (see Figure 8.4) reveals the areas of highest density occur in the southern and central portion of the excavation area. These areas of high debitage frequency represent production loci, dumps, or some combination of both. The vertical distribution of lithic debitage in Area 2 exhibits a greater vertical range, and flakes were found to a greater maximum depth than were projectile points and other lithic tools. The levels with the highest debitage frequencies also dip from west to east across the excavation area.

Within Area 2, several distinct groups of flaking debris were observed in the areas of high flake density. Twelve groups, identified by similarity of raw material type and technological attributes, are thought to represent at least 12 separate lithic reduction events. Seven of these groups are identified in the southern portion of Area 2 with the remaining five groups identified from test units in the central portion of the excavation area. The horizontal and vertical distribution of each of these groups is presented in Table 8.4.

Although the details of raw material and technological aspects of these flake groups are discussed in later sections, their spatial distributions may reveal as much about the nature of the deposits as they do about the reduction activities. The horizontal distributions of these groups range from 3 to 16 m^2 with an average area of ca. 9 m^2. Vertical distributions of these groups range from 20 to 70 cm and average ca. 43 cm. If these groups represent a multiple-episode lithic production area, the relatively large disbursement of materials within each group suggests displacement of materials by later human activities (i.e., later occupations) and postdepositional processes (i.e., colluvial slopewash). It seems that the best explanation of the horizontal distribution of all lithic materials is deposition as a series of dumps into a midden area. The mean vertical ranges of these groups suggest that lithic materials also have experienced vertical translocation by pedogenic processes or bioturbation.

Summary of Area 2

The southern half of the Area 2 excavation block is dominated by three large earth ovens and a more or less continuous scatter of burned rocks across the southern half of the excavation block. This area probably represents the lower portion of a burned rock midden, most of which was destroyed by the firebreak blading in 1996. Burned rocks and lithic artifacts are less frequent in the northern half of the excavation block, and this area appears to represent off-mound activities. Although many of the features are radiocarbon dated and can be placed in time, the artifacts cannot, and there is no clear association between specific artifacts and specific features. Most of the lithic artifacts represent, in all likelihood, discarded materials that were not functionally related to activities that the burned rock features represented. Throughout Area 2, the features and artifacts represent repeated activities over a long span of time, and there is no way to sort the artifactual evidence into distinct and meaningful components. In conclusion, all of the Area 2 cultural remains must be treated as a single analysis unit for most analytical purposes.

Area 3

Area 3 is dominated by the burned rock mound called Feature 3 (Figure 8.6). Within this excavation area, clear horizontal and vertical patterns are difficult to ascertain because deposits consist primarily of jumbled burned rocks making up a mound. Based on data retrieved from the mound and its internal earth oven, however, artifact counts and burned rock weights appear inversely related to one another (Figure 8.7). Four units at the center of the mound that adjoin or subsume the cooking pit produced 67.8 percent of the artifacts recovered from the mound or earth oven but yielded only 20.6 percent of the entire burned rock weight. In contrast, five excavations containing mound deposits and situated 1 to 2 m from the internal pit generated 15.9 percent of the total artifact assemblage and 57.6 percent of the burned rocks by weight. This patterning may indicate a buffer above and around the central oven where fewer rocks were discarded. This seems logical because opening, cleaning, re-lining, and firing the earth oven require that the area immediately around the pit be relatively clean for easier access to the cooking facility. The tendency would be to discard the unusable burned rocks to outside this work area.

The vertical distribution of burned rocks in a cross section of Area 3 (Figure 8.8) reveals that the burned rock mound (Feature 3) is the dominant feature and is more than 50 cm thick near its center. At the base of the mound, directly in its center, is the deep rock-lined pit that is

Table 8.4. Horizontal and vertical distributions of identifiable groups of unmodified debitage, Area 2, 41CV595

Group*	No. of Specimens	Chert Type	Heat Treatment	Horizontal Distribution (Test Units)	Vertical Distribution (Elevation, m)	No. of Cortical Specimens	Cortex Type	Qualitative Technological Assessment	Comments
1	17	Fort Hood Yellow	yes	48, 51, 52	99.50–99.30	8	polished	early-stage biface debitage	
2	73	Cowhouse White	yes	44, 45, 46, 51, 52	99.50–99.10	0	N/A	late-stage biface debitage	Manning Mountain variety; 63% recovered from 99.50–99.40
3	61	indeterminate light brown	no	29, 41,45, 46, 47, 48	99.6–99.0	4	rough limestone	middle to late-stage biface debitage	semi-translucent, light patination; 75% recovered from 99.50–99.30
4	97	Cowhouse White	no	37, 38, 39, 47, 48, 49, 51, 52	99.50–98.80	10	rough limestone	early- to middle-stage biface debitage	Manning Mountain variety
5	40	Fort Hood Yellow	no	39, 40, 41, 45, 46, 47, 48	99.50–99.10	2	rough limestone	middle- to late-stage biface debitage	
6	53	Cowhouse Two-Tone	no	39, 40, 42, 45, 46, 47, 48, 49, 51, 52	99.60–99.20	32	polished	core preparation or flake production debitage	light patination
7	60	indeterminate dark gray	no	39, 40, 42, 45, 46, 47, 48, 49, 51, 52	99.50–99.10	0	N/A	late-stage biface debitage	
8	32	indeterminate dark grey	no	16, 17, 18, 19, 21,22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32	99.63–99.30	2	Polished	late-stage biface debitage	
9	51	indeterminate light brown	no	16, 17, 18, 22, 23, 24, 25, 28, 29, 30, 31	99.63–99.20	0	N/A	middle to late-stage biface debitage	
10	66	Heiner Lake Translucent Brown	no	17, 18, 19, 21, 22, 23, 24	99.63–99.10	0	N/A	late-stage biface debitage	heavy patination
11	38	indeterminate white	no	16, 17, 18, 23, 24, 26, 28, 29, 30, 31, 32	99.63–99.20	7	weathered limestone rust weathering rind	core preparation/flake production debitage	Probable Manning Mountain procurement
12	39	indeterminate mottled	yes	15, 16, 18, 19, 21 ,22, 23, 24, 28, 29, 30, 31	99.57–99.20	0	N/A	late-stage biface debitage	light patination

*Groups may represent separate lithic reduction events.

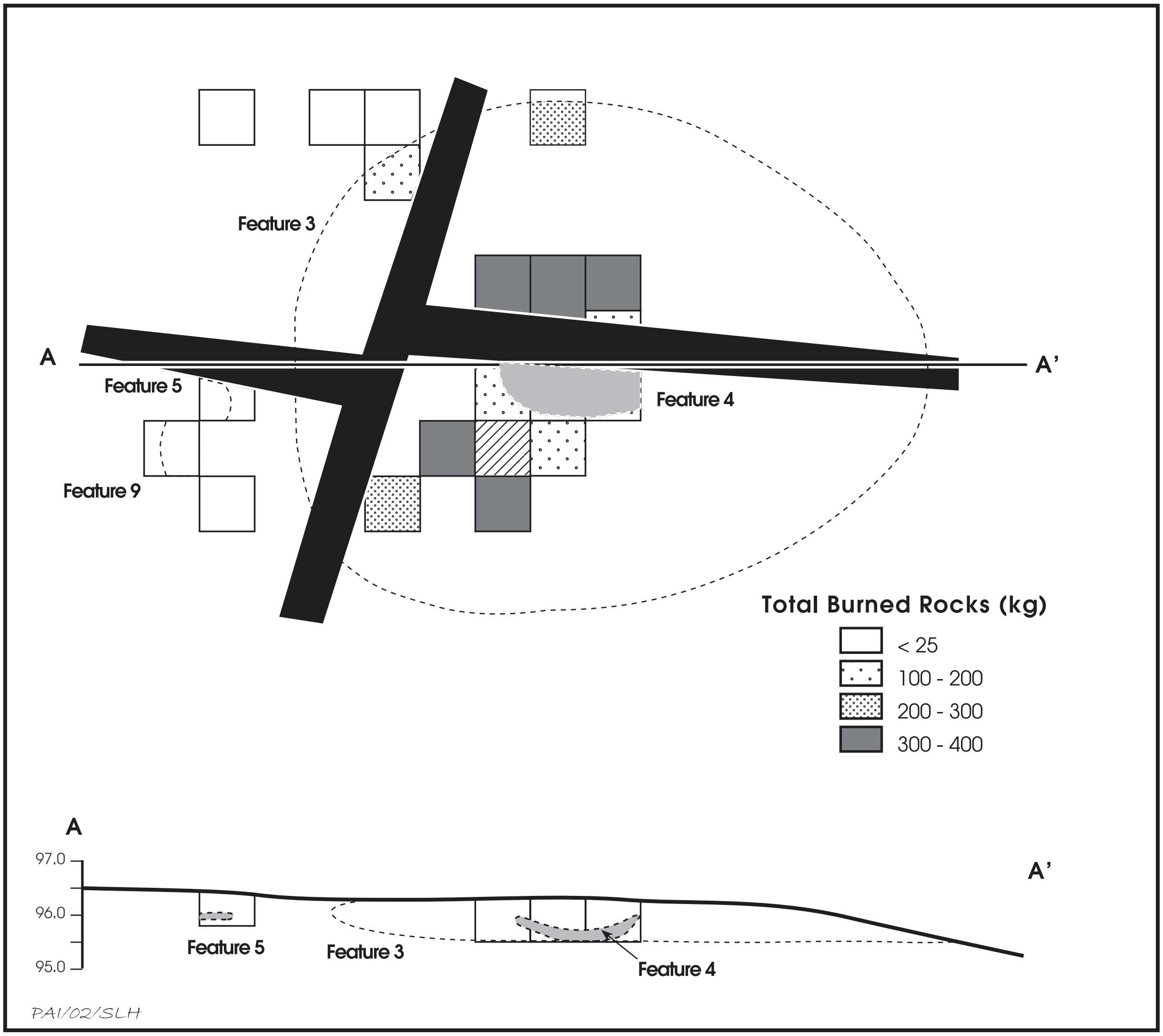

Figure 8.6. Plan and profile of Area 3 showing the burned rock mound and related features, 41CV595. Elevations are in meters.

interpreted as an earth oven (Feature 4). Just beyond the west edge of the mound is a cluster (Features 5 and 9) thought to represent dumps of burned rocks perhaps used in stone boiling.

A look at the vertical distribution of all lithic artifacts (Figure 8.9) shows that they range in elevation from 96.40 to 95.50 m, but artifact frequencies are highest between 96.20 and 95.90 m. The levels of highest artifact density dip from west to east across Area 3, and excavation of most units ended on weathered regolith or hard bedrock limestone. These data indicate that the mound developed on a natural eastward-sloping bedrock surface that approximates the modern slope in the site area (about 5 degrees).

Arrow and Dart Points

Horizontally, Area 3 shows a cluster of arrow points in Test Units 64 and 65 near the slab-lined earth oven (Feature 4). The horizontal distribution of 10 dart points and 1 preform (probable Darl) recovered from Area 3 exhibits one cluster in proximity to Features 3 and 4 in the eastern portion of the area and another cluster in proximity to Features 5 and 9 in the western part.

The stratigraphic positions of the arrow points and dart points show a distinct concentration in the upper mound layers, with 8 of the 14 points from 96.20 to 96.10 m. The mound deposits contain a mix of styles that represent some

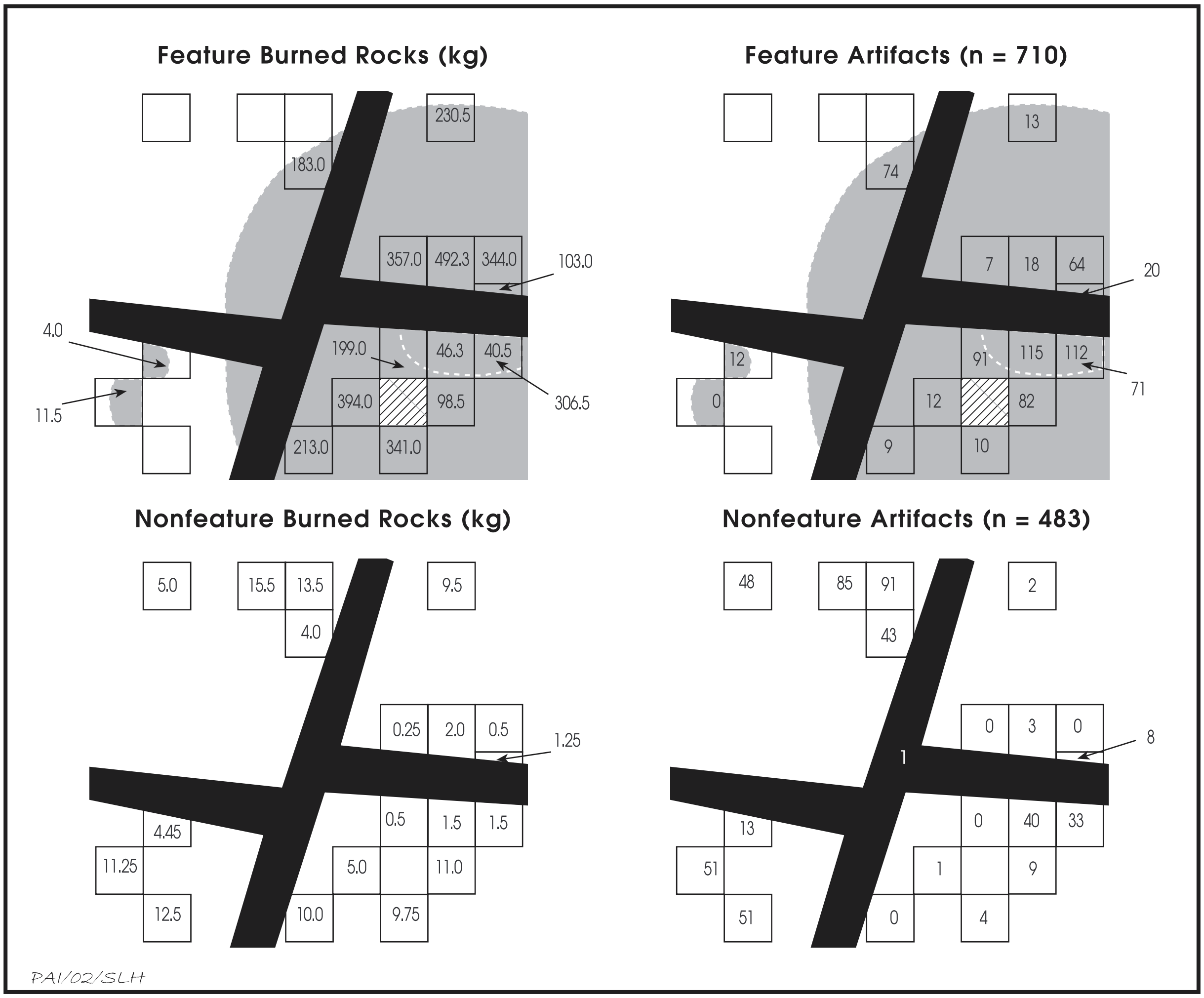

Figure 8.7. Horizontal distributions of stone artifacts and burned rocks from feature and nonfeature contexts in Area 3, 41CV595.

1,500 years, with Marshall, Ensor, and Darl dart points alongside and above Alba arrow points. The arrow points occur from 96.20 to 95.90 m, an elevation range that is consistent with the occurrence of six Late Archaic dart points and two untyped or untypeable dart points. It is clear from this evidence that dart and arrow points of different age are stratigraphically mixed throughout Area 3.

Other Lithic Tools

The horizontal distributions of 38 other lithic tools (all except projectile points) recovered from Area 3 are presented by artifact class in Figure 8.10. Even though the excavation area and sample size are small, these lithic tools show a relatively even horizontal distribution with two notable anomalies. A cluster of lithic tools (bifaces, edge-modified flakes, and unifaces) is apparent in Test Units 63, 64, and 65, where the total artifact frequencies are greatest. A second cluster (bifaces and edge-modified flakes) is seen in the area of Test Units 54, 55, and 57. In terms of stratigraphy, the other lithic tools exhibit a more limited vertical distribution than the vertical distribution of all lithic artifacts (see Figure 8.9).

Debitage

The horizontal distribution of flakes in Area 3 reveals the areas of highest densities occur in the southeast and northwest portions of the excavation area. These areas of high debitage frequency represent production loci or dumps.

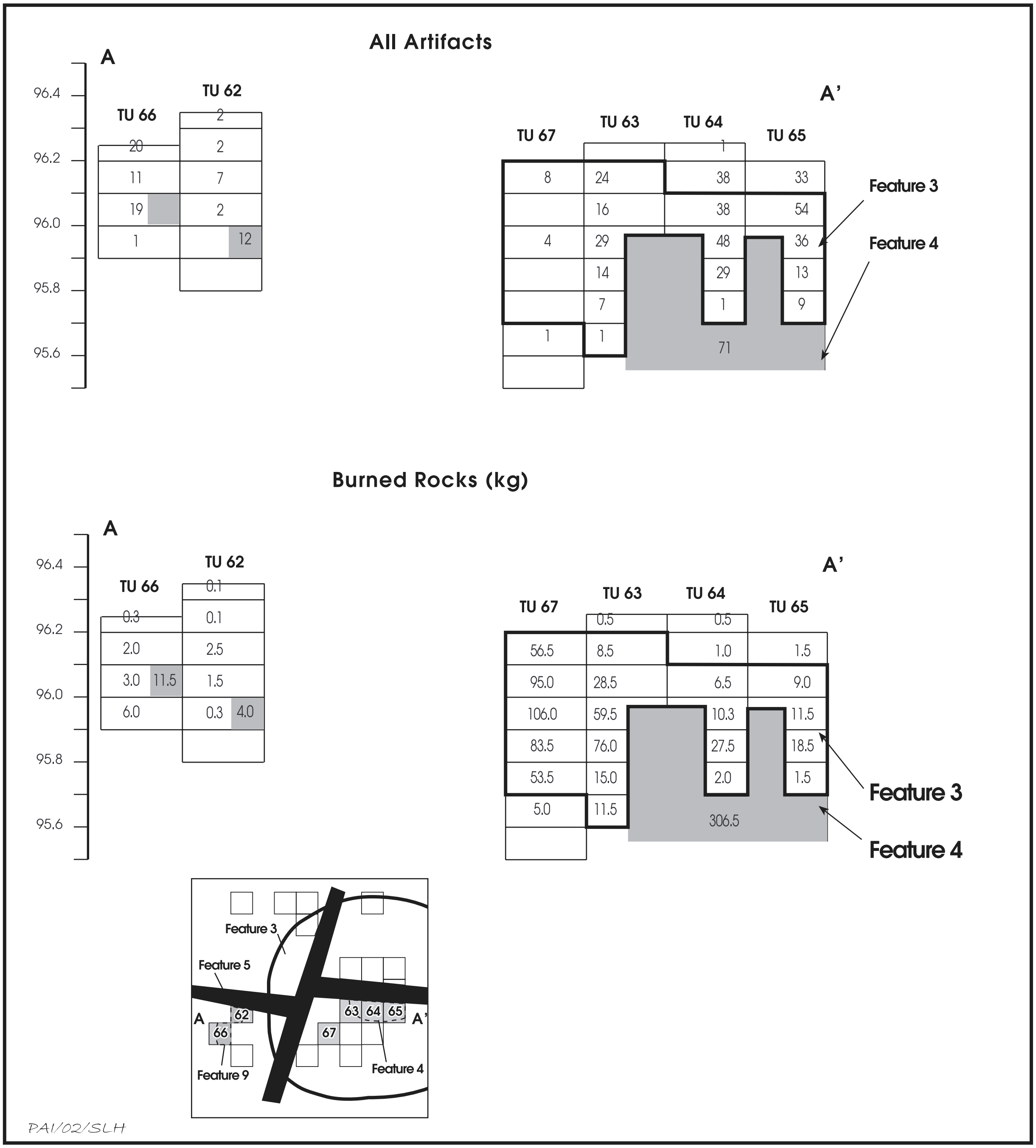

Figure 8.8. Schematic cross section showing the vertical distributions of all artifacts and burned rocks, by weight, from west to east across Area 3, 41CV595. Elevations are in meters.

Vertical distributions of lithic debitage in Area 3 (see Figure 8.9) show greater depth ranges than seen in the lithic tool category, and the debitage extends slightly deeper across the excavation area from west to east. Within Area 3, seven groups of flaking debris were observed in the areas of high density. These groups, identified by similarity of raw material and technological attributes, are thought to represent at least seven separate lithic reduction events. Four of these groups are identified in the southeastern portion of Area 3, and the other three groups are identified from test units in the northwestern portion of the excavation area. The horizontal and vertical distributions of each of these groups are presented in Table 8.5.

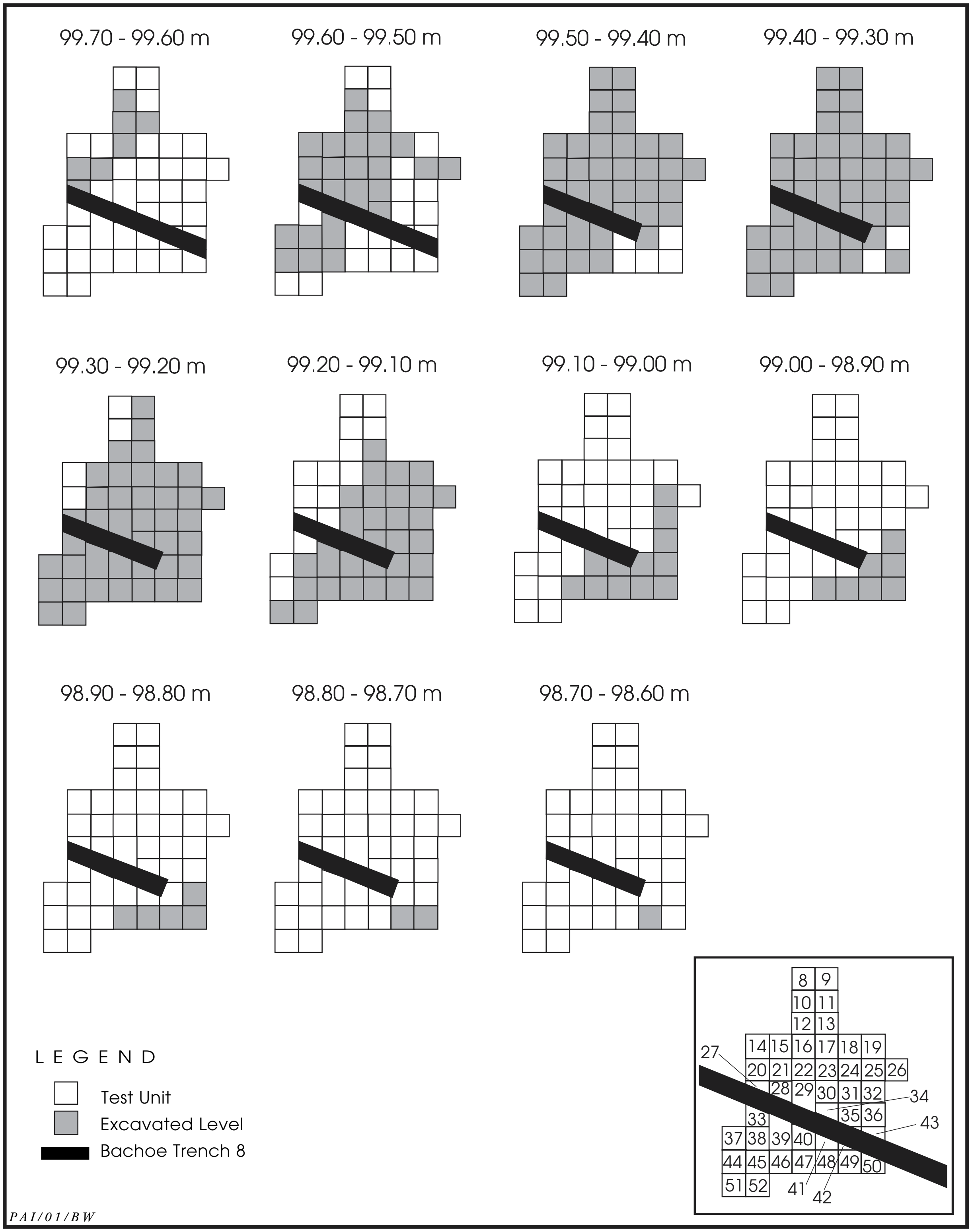

Figure 8.9. Horizontal and vertical (collapsed west-to-east cross sections) distributions of all lithic artifacts from feature and nonfeature contexts in Area 3, 41CV595. Elevations are in meters.

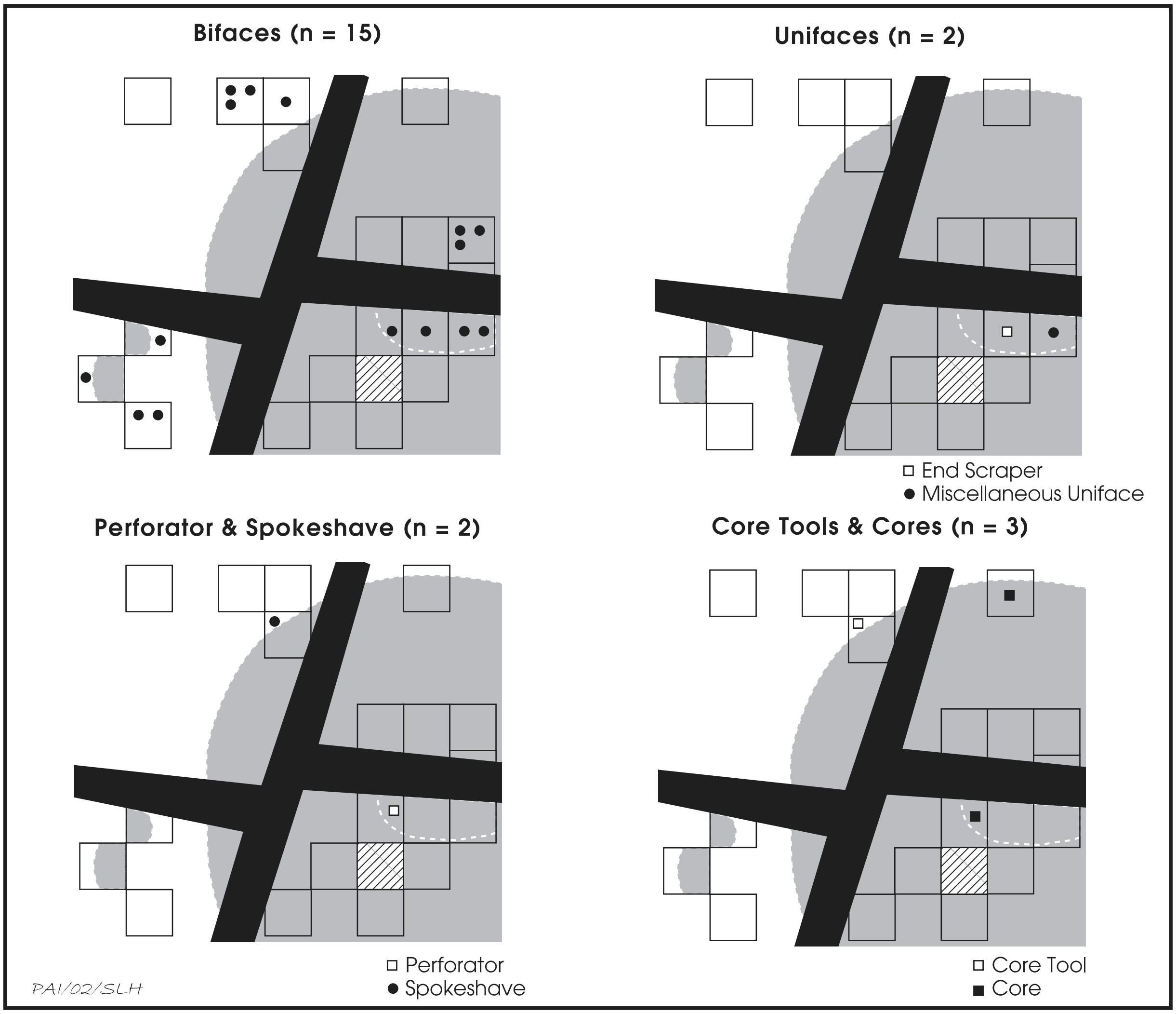

Figure 8.10. Horizontal distributions of other lithic tools in Area 3, 41CV595.

Although technological aspects of these flake groups are discussed in subsequent sections, their spatial distributions are useful for inferring the nature of the deposits. The horizontal extent of each group ranges from 3 to 8 m^2 with an average area of ca. 5 m^2. Collectively, these groups represent a multiple-episode production or dump area. Vertical distributions of these groups range from 30 to 68 cm and average about 40 cm. This distribution suggests that anthropogenic or biological agents have moved flakes vertically to some degree.

Summary of Area 3

The burned rock mound, with its central earth oven, was the principal activity in Area 3. The presence of nonfeature burned rocks and artifacts just beyond the northwest and southwest edges of the mound probably represents off-mound activities that could have occurred when the cooking facility was being used or during intervals when the oven was not in use. These off-mound activities are not independently dated, and it is not possible to separate these cultural materials into components, or to relate them temporally or functionally to the earth oven cooking activities that formed the mound.

The spatial analysis of Area 3 reinforces the idea that there is no way to isolate meaningful cultural components from within the burned rock mound, nor can the off-mound materials be sorted into temporal or cultural groups with any degree of confidence. Consequently, all of the Area 3 cultural materials and features must be treated as a single analysis unit.

Table 8.5. Horizontal and vertical distributions of identifiable groups of unmodified debitage, Area 3, 41CV595

Group*	No. of Specimens	Chert Type	Heat Treatment	Horizontal Distribution (Test Units)	Vertical Distribution (Elevation, m)	No. of Cortical Specimens	Cortex Type	Qualitative Technological Assessment	Comments
1	97	Fort Hood Yellow	yes	59, 60, 61, 62, 63, 64, 65, 68	96.20–95.80	10	abraded	early- to middle-stage biface debitage	
2	33	indeterminate light brown	no	59, 60, 61, 64, 65, 67, 68	96.28–95.60	7	rough limestone, rust weathering rind	core preparation or flake production debitage	Probable Manning Mountain procurement
3	14	indeterminate dark brown	no	61, 63, 64, 68	96.20–95.80	0	N/A	late-stage biface debitage	
4	20	Cowhouse Dark Gray	no	63, 63, 68	96.20–95.80	2	polished	core preparation or flake production debitage	
5	51	indeterminate white	no	53, 54, 55, 57	96.28–95.80	6	weathered limestone, rust weathering rind	core preparation or flake production debitage	Probable Manning Mountain procurement
6	18	fossiliferous pale brown	no	54, 55, 57	96.20–95.90	0	N/A	late-stage biface debitage	Probable Manning Mountain procurement
7	13	indeterminate light brown	no	53, 54, 55, 57	96.27–95.80	0	N/A	late-stage biface debitage	translucent, fossiliferous; Manning Mountain procurement

* Groups may represent separate lithic reduction events.

Discussion of Site Formation

In his book, *Principles of Geoarcheology*, Waters (1992:316) states that "it is necessary to determine if disturbance processes have affected a site, and if they have, to identify the types of processes and the extent of alteration. Once this is done, the limitations of the archaeological context are recognized and the accurate interpretation of human behavior is possible." It is obvious that the Firebreak site has been disturbed, and two further questions must be addressed. What types of post-depositional disturbances have occurred, and how extensive are the disturbances? And what limitations do these factors impose on interpreting human behaviors at the site?

The Firebreak site is typical of Paluxy sites on Fort Hood. It contains chipped stone artifacts and large quantities of burned rocks deposited by humans who lived on the sandy sediments derived from the Paluxy Formation. The surface elevation at Firebreak drops (from west to east) some 8 m vertically over a horizontal distance of about 100 m, forming an intermediate slope of 8 percent or about 5 degrees (average). Paluxy sediments accumulate on such intermediate (also called moderate) slopes through a series of erosional and depositional processes that expose and weather the Paluxy sandstone, move sediments through slopewash, and redeposit sediments in low gradient areas (see Kibler 1999). All of this is further complicated by the formation of rills and gullies and the subsequent infilling of those incised channels, and such major erosional and depositional events tend to be cyclical. Other factors then come into play as the sediments are reworked by animals and plants. All of these depositional and post-depositional processes are slow and continual, and the nature of the rocky hillslopes and Paluxy sand accumulations is constantly changing. Consequently, evidence of past human occupations of the Paluxy environment has been altered substantially, and much of it may have disappeared completely. Previous researchers noted that human occupations in Paluxy environments are dominantly late–within the last 3,000 to 4,000 years–and attribute this skewed temporal distribution to erosional stripping of earlier sediments and sites (Kibler 1999:57-58; Kleinbach et al. 1999:389).

Bioturbation and erosion are the two most significant processes that have disturbed cultural remains in Paluxy sediments over the millennia, and these factors certainly apply to the Firebreak site. Bioturbation from plant roots and animal and insect burrowing has been observed at Firebreak and other Paluxy sites (see Kibler 1999:Figure 10), but it is certain that much (if not most) of the evidence for such disturbances is not observable. Evidence of floralturbation and faunalturbation is not observed because the sandy Paluxy sediments are homogenous, which makes such disturbances virtually undetectable (Waters 1992:306–312). In simple terms, root casts and rodent burrows in reddish Paluxy sand will be nearly impossible to see if they collapsed or were filled in with the same sediment. It is clear that the paucity of evidence of bioturbation in the upper culture-bearing (Stratum I) deposits at Paluxy sites does not mean that these disturbances did not occur. Admittedly, it is impossible to know how much bioturbation has affected the archeological materials at Firebreak, but it is likely that the cultural deposits are riddled with root casts and insect and animal burrows that are no longer evident. The evidence of bioturbation that is observable probably represents only the most recent of animal and plant disturbances.

In sandy soils, artifacts of all sizes may be moved considerable distances–both upward and downward–by insects, rodents, and plant roots (Wood and Johnson 1978). At an upland sandy site (41FT334) in east Texas, for example, small historic artifacts that originated from an occupation in the upper 70 cm were carried down-profile, most likely by rodents, into the prehistoric deposits to depths as great as 310 cm (Boyd 1991:447; Fields et al. 1991:141). In contrast, Bocek (1986) argues that burrowing activity tends to move objects upward in archeological sites because animals generally move sediment up to the surface. In many ways, Paluxy sites are analogous to the upland "sandy mantle" of east Texas, and the contextual integrity of such sites has been the subject of much archeological debate (see Thoms 1998).

Downslope movement of sediments and artifacts by water and gravity are further factors causing mixing of cultural materials and obscuring cultural patterning in Paluxy sites. On intermediate slopes such as at the Firebreak site, deposits are subject to two main types of erosional disturbances—overland flow and soil creep (Butzer 1976:90–92; 101–103). Butzer (1976:101–103) notes that overland flow on moderate slopes includes sheet erosion (often called slope wash), rill erosion, and gully cutting. The effects of these processes have been seen at many Paluxy sites, and these processes are still in operation today, especially in locations where ground cover vegetation is sparse or absent. These processes would have been most pronounced during extremely dry periods when cover vegetation was at its lowest. Waters (1992: 301–304) defines soil creep as "the slow downslope movement of surficial unconsolidated sediment and soil particles under the influence of gravity." He goes on to state: "While this downslope movement is slow and almost imperceptible on an annual basis, over many years the cumulative effects of these processes are discernable and may grossly disturb the archaeological context of a site."

All of the factors mentioned above were in effect, to one degree or another, at any given Paluxy site. The presence of well-patterned hearths and earth ovens indicates that contextual associations are intact in some places on many Paluxy sites, but these cases may be limited only to features constructed of large rocks. The areas characterized by scattered burned rocks and chipped stone artifacts seem to have no meaningful vertical or horizontal patterning, as evident in the distributional analyses of Firebreak materials earlier in this chapter. These areas could represent in situ deposits of materials that prehistoric inhabitants kicked around on living surfaces, cultural deposits that postdepositional processes completely reworked and redeposited, or some degree of both. The latter interpretation is most viable**.**

In conclusion, the very nature of the sandy sediments leads one to determine that postdepositional movement of sediments and artifacts has been significant on Paluxy sites. Untold numbers of burrowing rodents and insects, as well as countless trees and shrubs, have lived and died on Paluxy sands over many thousands of years. All the while, the loosely consolidated sediments on which people lived were being moved downslope by water and gravity. It is impossible to measure the degree of these disturbances accurately at any one site, but we must assume that they have been especially significant in all cases where the culture-bearing Paluxy sediments are less than a meter thick. We should not, however, rule out the possibility that some degree of cultural stratification might be preserved in deeper deposits—those more than 2 m deep—where incised gullies were rapidly filled in. As for the Firebreak site, it must be concluded that the precise contextual relationships among artifacts have been seriously compromised by erosion and bioturbation (e.g., Bocek 1986; Waters 1992:291; Wood and Johnson 1978). The cumulative disturbances might be called a shifting-sands effect in which the provenience associations seen in the archeological record do not translate directly or easily into interpretations of human behavior. The result for the Firebreak materials is that there is little or no meaning in the small scale horizontal and vertical patterning of artifacts and there is no way to separate the artifacts into assemblages that represent different occupation episodes or time periods. Features composed of large objects—that is, burned rocks—are relatively intact in some cases, and inferring a direct association between a feature and datable charred organic remains found in its fill is reasonable. But the association between chipped stone artifacts and the burned rock features they are found near is tenuous, and assumptions of contemporaneous deposition or functional association are shaky at best.

Definition of Components

The total span of prehistoric cultural activities at the Firebreak site—as indicated by radiocarbon assays—is long, somewhere on the order of 1,420 to 2,053 years (from earliest to latest date). Occupations began between 790 and 430 B.C. during the middle of the Late Archaic and lasted to as late as A.D. 990–1263 during the Toyah phase of the Late Prehistoric period. The cultural remains from these periods were found in horizontally separate areas, but attempts to sort them into distinct groups representing individual components (i.e., debris from a single group of people at one particular time) were not productive. This difficulty may be attributed, to a large degree, to postdepositional disturbances and the nature of the Paluxy sands. Previous researchers recognized that interpreting the material culture from Paluxy sites might be problematic (see Abbott 1995:821–823; Boyd 2000:37), but a single component assumption was not made at the outset. Having thoroughly examined the horizontal and vertical artifact distributions, the only conclusion that may be reached is that the archeological remains from each excavation area at Firebreak must be treated as components for most analytical purposes. For other analytical purposes, it is reasonable to lump all of the Firebreak materials and consider them as a single component.

Although the above discussion of site formation and the conclusion of single componency for the Firebreak site may sound like a condemnation of Paluxy site archeology, they are not. Rather, they are simply acknowledgements of the inherent limitations of prehistoric archeological evidence found in sandy soils. As is demonstrated later in this chapter and in Chapter 9, Paluxy sites like Firebreak have much to offer despite these inherent limitations. The uniqueness of the Paluxy setting within the rocky upland landscape makes all Paluxy sites potentially significant for what they can contribute to our knowledge of human activities on the upland slopes away from the main river and stream channels. As discussed in the rest of this chapter, the Firebreak data recovery suggests some important patterns of long-term continuity in lithic procurement strategies, subsistence technologies and resources, and site function and seasonal occupation.

LITHIC PROCUREMENT AND REDUCTION STRATEGIES

This section addresses raw material procurement practices and stone reduction strategies of the hunter-gatherers who inhabited the Firebreak site. This analysis uses the existing Fort Hood chert taxonomy, augmented by additional chert sampling near Manning Mountain, to examine the chipped stone tools and debitage from the site. The four topics that are considered in this section are lithic sourcing, lithic technology, heat treatment, and functional interpretations. For the lithic sourcing and lithic technology discussions, two levels of analysis are presented. One level looks at each of the three excavation areas separately (i.e., as separate components), and the other looks at the combined lithic assemblage from all three excavation areas.

Lithic Sourcing at Fort Hood

Considerable effort has been devoted to identifying and classifying the extensive and variable Edwards chert sources in the Fort Hood Area (Dickens 1993a and 1993b, Frederick and Ringstaff 1994, Abbott and Trierweiler 1995a, D. Boyd 1999).

These efforts have culminated in a fairly comprehensive chert taxonomy that differentiates many types of cherts by specific attributes such as color, texture, and inclusions. Each chert type is linked to a source area, some are attributed to very specific geographic locations and precise geologic settings, and others are linked to broad areas and general geologic contexts.

The heterogeneity of Edwards chert across the base is evident in this typology and would appear to lend itself well to geographic sourcing of lithic assemblages. But some problems exist with the current taxonomy that could bias the analyst and yield erroneous interpretations of lithic sourcing of particular chipped stone assemblages. Taxonomy problems encountered in the early stages of this sourcing study include inadequate representation of chert outcrops from the northwest portion of the base and homogeneity between outcrops from different chert provinces across the base. Of particular relevance to this study are the chert outcrops found on and around Manning Mountain, as well as secondary sources in the West Range area that are not represented in the Fort Hood chert taxonomy.

To compensate for the lack of chert sourcing data for Manning Mountain, a literature review was conducted to identify all recorded lithic procurement sites within a five kilometer radius of 41CV595. Seven chert procurement sites were identified: 41CV71, 41CV125, 41CV935, 41CV944, 41CV1026, 41CV1033, and 41CV1092. Once the literature review was completed, the previously collected chert samples from those sites, which are housed at the Cultural Resources Management Program curation facility at Fort Hood, were examined. Further data on these nearby chert sources was obtained during a field trip.

On 27 February, 2001, a reconnaissance of Manning Mountain was conducted to confirm and augment data on the distribution and variability of chert sources represented by the previously collected samples. Nine places at the seven chert procurement sites were visited, and additional samples were collected. Locations of the chert procurement sites and the nine new collection localities are shown in Figure 8.11. The naturally occurring cherts from these sites are characterized in Table 8.6.

The reconnaissance proved important in understanding chert variability and distribution in the Manning Mountain region. This, in turn, allowed more meaningful interpretations of Late Archaic and Late Prehistoric raw material procurement strategies reflected in the Firebreak site lithic assemblage.

Most striking among the findings of the Manning Mountain reconnaissance survey were two unexpected chert types—Cowhouse White and Fossiliferous Pale Brown (defined in Abbott and Trierweiler 1995:Appendix I; Trierweiler ed. 1994:Appendix C). These types were previously thought to occur only in restricted areas in the eastern portion of the base, but analogs of these chert types were noted in the materials collected from sites 41CV125, 41CV935, and 41CV1092. A distinctive translucent light brown chert found and sampled from the northern portion of 41CV944 has several unique properties, including fibrous fossiliferous inclusions, translucency, and a greenish florescent response to ultraviolet light. Perhaps this material will prove to be distinctive enough to warrant a new chert type designation, but none can be assigned based on this small, single sample. Materials from 41CV1026 varied considerably in color and texture, but this variation probably represents the normal range of variability for the Manning Mountain cherts.

All of the cherts found on top of Manning Mountain are presumed to represent primary sources, but no actual bedded cherts were observed, and more work would be needed to confirm this conclusion. During the survey, it also was observed that the colluvial slopes on the southern and western margins of Manning Mountain have considerable quantities of good-quality chert.

Frederick and Ringstaff (1994:140) note that various cherts were left behind as secondary deposits on the Killeen surfaces as higher limestone layers of the Manning Mountain eroded away. This means that the inhabitants at Firebreak had access to an abundant source of high-quality secondary cherts very close by and would not have to expend the energy to climb Manning Mountain to access the primary bedrock source.

Lithic Sourcing at Firebreak

Raw material sourcing was conducted to understand lithic procurement practices of Late Archaic and Late Prehistoric hunter-gatherers at Firebreak. It should be noted that qualitative sourcing is not an exact science. This issue was previously addressed by D. Boyd (1999), who conducted a chert-typing replicability study and concluded there is significant potential for erroneous sourcing results because of at least two factors: the presence of secondary (stream gravel and upland lag) raw materials analogous to bedrock sources defined only in the southeast portion of the base and varying degrees of consistency between individual lithic analysts. Acknowledging these factors, the subjectivity of identifying chert sources in this manner is minimized by rigorously applying identification criteria and conservatively assigning types (i.e., questionable specimens are not typed). For the Firebreak site analysis, one analyst experienced in raw material sourcing and lithic analysis in the Fort Hood region examined the entire assemblage.

Consequently, any inconsistencies encountered in this analysis, particularly with examining 3,253 pieces of lithic debitage, are attributable to uncertainties inherent in the chert taxonomy rather than variability between analysts.

Area 1

The chipped stone assemblage recovered from Area 1 consists mainly of cherts from indeterminate sources, and only 3.3 percent of the artifacts are assigned to chert types (Table 8.7). Four of the flakes are identified as Cowhouse White (n = 3) and Cowhouse Two-Tone (n = 1), both of which are found in the Manning Mountain area (see Table 8.6). In light of recent sourcing research in the area, however, seven other specimens can now be identified as local materials with reasonable certainty. Some characteristics of these specimens, primarily the look and feel of their cortices, offer clues as to their origin, but they remain classified as indeterminate.

Of the three edge-modified flakes recovered from Area 1, two show weathered limestone cortex that may have originated from either upland or lag environments. The remaining specimen exhibits no cortex. All three of the

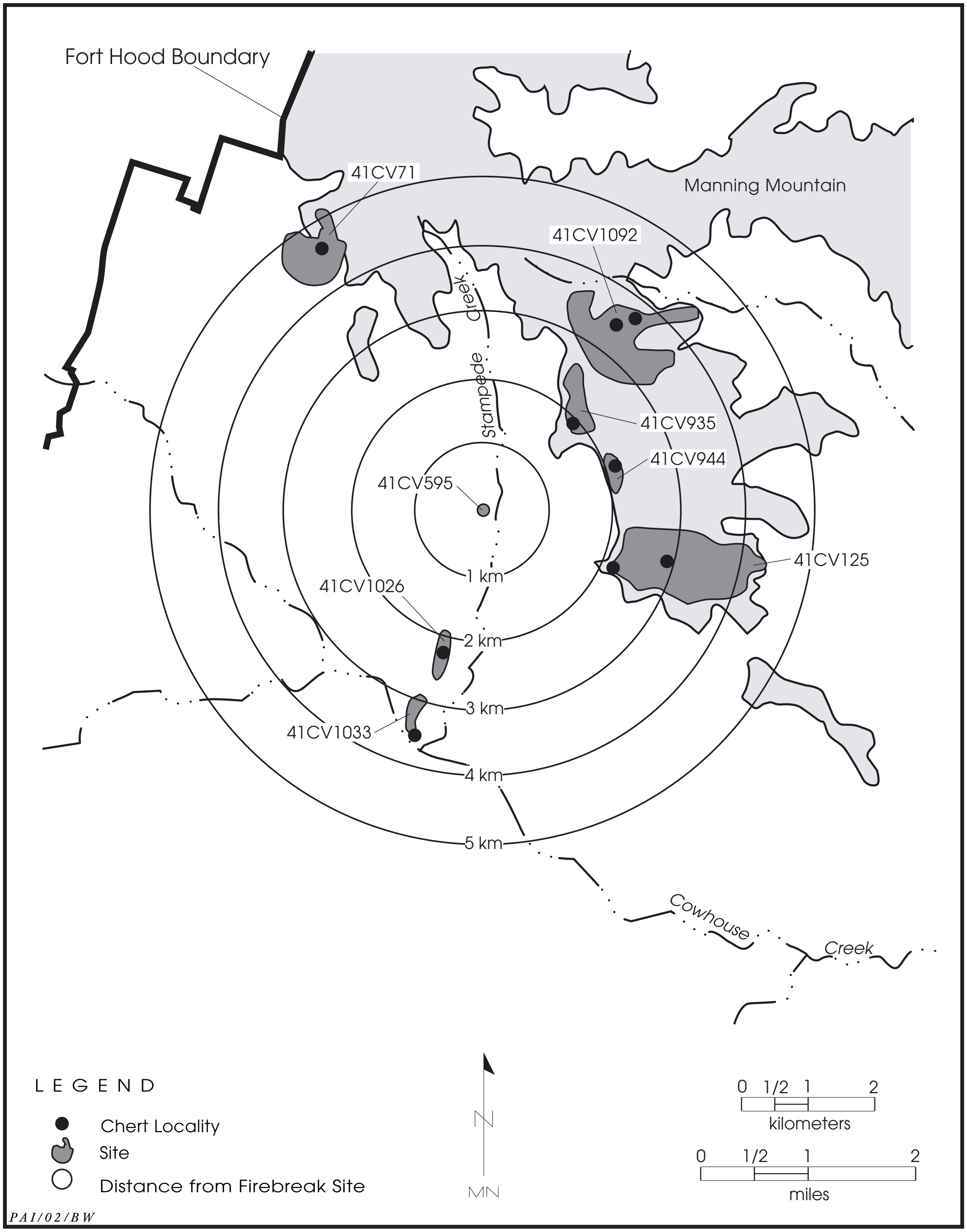

Figure 8.11. Map of Manning Mountain area chert procurement sites and sample locations within a 5-km radius of the Firebreak site (see Table 8.6).

Table 8.6. Characterization of natural chert samples from selected sites in the vicinity of Manning Mountain (5-km radius of 41CV595)

Site	Setting	Occurrence	Color	Texture	Structure	Translucency	Cortex	Comments
41CV71	Manning surface	indeterminate	N7/0 light gray	medium	homogenous	opaque	highly patinated weathering rind	Limited Sample
41CV125	Manning surface	irregular nodules of variable size	10YR 8/6 pale yellowish orange 10YR 7/4 grayish orange	variable medium to coarse	mottled with fossil inclusions	opaque	weathered limestone often with ferrous staining between fractured nodules	analogous to Fossilferrous Pale Brown (Type 7)
41CV125	Manning surface and slope colluvium	irregular nodules of variable size	ranges from 5YR 6/1 light brownish gray, N7 light gray, N9 white	variable medium to coarse	slightly mottled to slightly banded	opaque with occasional semitranslucent bands near cortex	weathered limestone often with ferrous-stained rind	analogous to Cowhouse White (Type 2)
41CV935	Manning surface and slope colluvium	irregular nodules of variable size	ranges from 5YR 6/1 light brownish gray, N7 light gray, N9 white	variable medium to coarse	slightly mottled to slightly banded	opaque with occasional semitranslucent bands near cortex	weathered limestone often with ferrous-stained rind	analogous to Cowhouse White (Type 2)
41CV944	Manning surface	generally smaller nodules <20 cm	ranges from 10YR 6/2 pale yellowish brown to 10YR 7/4 grayish orange	variable fine to coarse	homogenous to mottled with many small white filaments	translucent to opaque	weathered limestone or highly patinated weathering rind	unique green florescence
41CV1026	Killeen surface (secondary?)	irregular nodules of variable size	ranges from 10YR 6/2 pale yellowish brown, N7 light gray, N9 white	variable medium to coarse	mottled to banded	opaque occasionally semitranslucent	weathered limestone often with ferrous-stained rind	variability within the range of the Upland Manning Mountain cherts
41CV1033	Cowhouse gravel	cobbles of variable size and shape	See Cowhouse cherts listed in Abbott and Trierweiler (1995:Appendix I)	variable fine to coarse	see Cowhouse cherts listed in Abbott and Trierweiler (1995: Appendix 1)	opaque to semitranslucent	abraded or polished limestone or chert rind	includes all Cowhouse cherts listed in Abbott and Trierweiler (1995: Appendix I)
41CV1092	Manning surface	irregular nodules of variable size	10YR 6/2 pale yellowish brown, 10YR 7/4 grayish orange, 10YR 8/6 pale yellowish orange	variable medium to coarse	mottled w/ fossil inclusions	opaque	weathered limestone often with ferrous staining between fractured nodules	similar to fossilferrous Pale Brown (Type 7)
41CV1092	Manning surface and slope colluvium	large ovate to disk-shaped nodules often broken into smaller pieces	ranges from 5YR 6/1 light brownish gray, N7 light gray, N9 white	variable medium to coarse	slightly mottled to slightly banded	opaque	weathered limestone often with ferrous-stained rind	analogous to Cowhouse White (Type 2)

Notes: Examined chert samples include those previously collected by Mariah Associates, Inc., from 1991 to 1995 and those collected by Prewitt and Associates, Inc., in 2001. Colors are determined according to the Rock Color Chart (Geological Society of America, 1980 printing).

Table 8.7. Chert types represented in the chipped stone artifacts, Area 1, 41CV595

Chert Type	Edge-modified flakes	Cores	Tested cobble	Unmodified flakes	Total
Cowhouse Two Tone	–	–	–	1	1
Cowhouse White	–	–	–	3	3
indeterminate dark brown	–	–	–	5	5
indeterminate dark gray	–	–	–	11	11
indeterminate light brown	1	1	1	25	28
indeterminate light gray	–	–	–	5	5
indeterminate mottled	2	1	–	26	29
indeterminate red	–	1	–	14	15
indeterminate white	–	–	–	24	24
Total	3	3	1	114	121

tools are within the range of colors and textures available from sources in proximity to 41CV595.

The three cores recovered from Area 1 offer a few clues to their sources. One specimen identified as indeterminate light brown chert shows distinctive properties including high translucency, fossiliferous inclusions, and green fluorescence. The fluorescence was observed on chert only from one discrete locality (i.e., 41CV944) on the western margin of the Manning Mountain (see Table 8.6 and Figure 8.11). Another exhibits a highly patinated weathering rind, and this core could have been acquired on a primary outcrop or from an exposure of secondary materials. The third core has an abraded cortex and was likely procured from local lag or stream bedload sources.

A single, large, tested piece of tabular chert categorized as indeterminate light brown could not be assigned to a Fort Hood type. The specimen, which exhibits rough limestone cortex and an iron oxide-stained weathering rind, is likely from the upland surface or a colluvial slope of Manning Mountain. Its cortex and distinct weathering rind appear to be common attributes of cherts in the Manning Mountain source areas (see Table 8.6 and Figure 8.11).

Three varieties of indeterminate cherts—light brown, light gray, and white—account for 47.1 percent of the Area 1 chipped stone assemblage. These light-colored varieties probably represent locally available materials. The indeterminate cherts that are darker in color may represent materials that are not found in the immediate area, but the red cherts probably represent either heat-treated materials or materials discarded very close to cooking features.

Area 2

Indeterminate cherts dominated the chipped stone assemblage from Area 2, although 26.5 percent of the assemblage is identified to specific chert types (Table 8.8). The ranges of colors and textures of these materials suggests, however, that a large percentage of the lithic tools and debitage are made from locally available cherts from Manning Mountain and lag deposits on the Killeen surface (such as at 41CV1026).

Projectile points might show the greatest variability in chert sources because these tools were often curated over relatively long periods and were likely to be carried greater distances (Bettinger 1991:69). As these tools were produced, maintained, and discarded, raw materials from different areas were transported and deposited at different sites across the landscape. Of the 16 total projectile points and preforms, only 7 were identified as named cherts within the Fort Hood chert taxonomy.

Projectile points made of chert from the North Fort Chert Province include an arrow point preform made of Fort Hood Yellow, two Ensor points of Fort Hood Yellow and Owl Creek Black, and an untypeable dart point of Owl Creek Black.

Projectile points made from cherts from the West Range Chert Province include one Ensor point made of Anderson Mountain Gray and one untypeable dart point of Seven Mile Mountain Novaculite. From the Southeast Range Chert Province, one Darl point is made of Heiner Lake Blue chert.

The other nine projectile points are made of indeterminate cherts. Of these, 2 Darl points, 1 Ensor point, and 1 untypeable fragment are

Table 8.8. Chert types represented in the chipped stone artifacts, Area 2, 41CV595

Chert Type	Arrow point preform	Dart points	Early- to middle-stage bifaces	Late-stage to finished bifaces	Misc. biface	End scraper	Side scraper	Misc. unifaces	Spoke-shave	Burins	Core tool	Edge-modified flakes	Cores	Unmodified fakes	Total
Anderson Mountain Gray	–	1	1	–	–	–	–	–	–	–	–	1	–	52	55
Cowhouse Dark Gray	–	–	–	–	–	–	–	–	–	–	–	–	–	3	3
Cowhouse Mottled with Flecks	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
Cowhouse Streaked	–	–	–	–	–	–	–	–	–	–	–	–	–	2	2
Cowhouse Two Tone	–	–	–	–	–	–	–	–	–	–	–	–	–	19	19
Cowhouse White	–	–	1	1	–	1	–	–	–	–	–	3	–	216	222
Fort Hood Gray	–	–	–	–	–	–	–	–	–	–	–	–	–	7	7
Fort Hood Yellow	1	1	–	–	–	–	–	–	–	–	–	–	–	80	82
Gray-Brown-Green	–	–	–	–	–	–	–	–	–	–	–	–	–	9	9
Heiner Lake Blue	–	1	–	1	–	–	–	–	–	1	–	1	–	43	47
Heiner Lake Blue -Light	–	–	–	–	–	–	–	–	–	–	–	1	–	10	11
Heiner Lake Translucent Brown	–	–	–	–	–	–	–	–	–	–	–	–	–	74	74
Owl Creek Black	–	2	–	–	–	–	–	–	–	–	–	–	–	14	16
Seven Mile Mountain Novaculite	–	1	–	–	–	–	–	–	–	–	–	–	–	1	2
Subtotal	1	6	2	2	0	1	0	0	0	1	0	6	0	531	550
indeterminate black	–	–	–	–	–	–	–	–	–	–	–	–	–	5	5
indeterminate dark brown	–	–	–	–	–	–	–	–	–	–	–	–	–	42	42
indeterminate dark gray	–	2	–	–	–	–	–	–	–	–	–	1	–	219	222

Table 8.8, continued

Chert Type	Arrow point preform	Dart points	Early- to middle-stage bifaces	Late-stage to finished bifaces	Misc. biface	End scraper	Side scraper	Misc. unifaces	Spoke-shave	Burins	Core tool	Edge-modified flakes	Cores	Unmodified fakes	Total
indeterminate light brown	–	2	2	–	–	–	–	1	–	1	1	2	1	537	547
indeterminate light gray	–	1	2	1	1	–	–	1	1	–	–	4	3	294	308
indeterminate mottled	–	2	–	1	–	–	1	1	–	–	–	4	1	138	148
indeterminate red	–	–	1	1	–	–	–	–	–	–	–	–	–	34	36
indeterminate white	–	2	3	2	–	–	–	–	–	1	–	3	7	198	216
indeterminate yellow	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
Subtotal	0	9	8	5	1	0	1	3	1	2	1	14	12	1,468	1,525
Total	1	15	10	7	1	1	1	3	1	3	1	20	12	1,999	2,075

made of white and light brown opaque chert that is consistent with cherts observed on Manning Mountain and at 41CV1026.

Compared to the projectile points, other lithic tools have a much higher percentage of indeterminate chert at 81.8 percent (n = 54). The remaining 18.2 percent (n = 12) consist of tools identified as specific chert types.

Bifaces and edge-modified flakes have the highest frequency of identifiable cherts. The bifaces consist of 2 Cowhouse White specimens, 1 Anderson Mountain Gray specimen, and 1 Heiner Lake Blue specimen. The Cowhouse White specimens are most likely from Manning Mountain.

The edge-modified flakes consist of 3 Cowhouse White specimens, 1 Anderson Mountain Gray specimen, 1 Heiner Lake Blue specimen, and 1 Heiner Lake Blue-Light specimen. The two remaining tools made of identifiable cherts are an end scraper made of Cowhouse White chert and a burin made of Heiner Lake Blue chert. The Cowhouse White end scraper shows rough limestone cortex and an iron oxide stained weathering rind on its dorsal surface; these traits resemble the Cowhouse White analogs observed on Manning Mountain.

The other lithic tools made of indeterminate cherts are dominated by white (n = 16), followed by light gray (n = 13) and light brown (n = 8). These colors are consistent with cherts from Manning Mountain and lag deposits at 41CV1026, and many specimens exhibit rough limestone cortices and iron oxide weathering rinds consistent with Manning Mountain cherts.

Lithic debitage recovered from Area 2 consists of 73.4 percent indeterminate cherts (n = 1,468) and 26.6 percent (n = 531) identified to specific chert types. The identifiable cherts consist predominately of Cowhouse White (40.7 percent), followed by Fort Hood Yellow (15.1 percent), Heiner Lake Translucent Brown (13.9 percent), Anderson Mountain Gray (9.8 percent).

Most or all of the Cowhouse White specimens are probably from the Manning Mountain area. Light brown dominates the indeterminate cherts, followed by light gray, dark gray, white, and mottled. It is likely that the lighter colored cherts (n = 1,029) represent locally available materials, and they account for 70.1 percent of the indeterminate chert specimens.

Area 3

As was true for Areas 1 and 2, indeterminate cherts (77.5) dominate the chipped stone assemblage from Area 3, with less than one-quarter of the specimens (n = 268) identified to specific chert types in the Fort Hood chert taxonomy (Table 8.9). Like Area 2, a large percentage of the lithic tools and debitage are probably made from locally available cherts that were obtained from the Manning Mountain area.

Of the 15 projectile points and preforms, 6 were identified to named types. Projectile points made of chert from the North Fort Chert Province include a Perdiz arrow point made of Fort Hood Yellow, one Ensor point made of Fort Hood Gray, and one Marshall point made of Fort Hood Gray. From the Southeast Range Chert Province, one Ensor point is made of Heiner Lake Tan, and one Ensor point is made from Cowhouse White. It is possible that some of these raw materials, especially the Cowhouse White, were obtained from the Manning Mountain area. Of the eight projectile points made of indeterminate cherts, two are Alba arrow points, one is an arrow point preform, and one is a light brown untypeable dart point. One Darl point and two Ensor points are made of light gray chert. Two other Ensor points are made of dark gray and red chert. Finally, one dart point preform (cf. Darl) is made of dark brown chert.

Other lithic tools have a much higher percentage of indeterminate chert at 86.8 percent (n = 33). The other 13.2 percent (n = 5) are identified as specific types in the Fort Hood chert taxonomy. These include four edge-modified flakes (one Fort Hood Yellow, one Gray-Brown-Green, and two Cowhouse White) and one biface (Anderson Mountain Gray). Other lithic tools made of indeterminate cherts include light brown (n = 15), followed by light gray (n = 3), and white (n = 1). Many of these light-colored specimens are consistent with cherts from the Manning Mountain sample areas (see Figure 8.11). These specimens show a rough limestone cortex and iron oxide weathering rind similar to those seen in many of the Manning Mountain chert samples (see Table 8.6). The other indeterminate specimens consist of mottled (n = 9), dark gray (n = 3), and red (n = 1).

Chert types represented in the Area 3 debitage sample consist of 77.5 percent indeterminate cherts (n = 883) and 22.5 percent

Table 8.9. Chert types represented in the chipped stone artifacts, Area 3, 41CV595

Chert Type	Arrow points	Dart points	Dart point preform	Perforator	Early- to middle-stage bifaces	Late-stage to finished bifaces	End scraper	Misc. uniface	Spoke shave	Core tool	Edge-modified flakes	Cores	Unmodified flakes	Total
Anderson Mountain Gray	–	–	–	–	1	–	–	–	–	–	–	–	7	8
Cowhouse Dark Gray	–	–	–	–	–	–	–	–	–	–	–	–	14	14
Cowhouse Mottled with Flecks	–	–	–	–	–	–	–	–	–	–	–	–	1	1
Cowhouse Novaculite	–	–	–	–	–	–	–	–	–	–	–	–	1	1
Cowhouse Two Tone	–	–	–	–	–	–	–	–	–	–	–	–	12	12
Cowhouse White	–	1	–	–	–	–	–	–	–	–	2	–	9	12
Fort Hood Gray	–	2	–	–	–	–	–	–	–	–	–	–	2	4
Fort Hood Yellow	2	–	–	–	–	–	–		–	–	1	–	83	86
Fossiliferous Pale Brown	–	–	–	–	–	–	–	–	–	–	–	–	10	10
Gray-Brown-Green	–	–	–	–	–	–	–	–	–	–	1	–	71	72
Heiner Lake Blue	–	–	–	–	–	–	–	–	–	–	–	–	8	8
Heiner Lake Blue -Light	–	–	–	–	–	–	–	–	–	–	–	–	20	20
Heiner Lake Tan	–	1	–	–	–	–	–	–	–	–	–	–	–	1
Heiner Lake Translucent Brown	–	–	–	–	–	–	–	–	–	–	–	–	16	16
Owl Creek Black	–	–	–	–	–	–	–	–	–	–	–	–	3	3
Subtotal	2	4	0	0	1	0	0	0	0	0	4	0	257	268
indeterminate black	–	–	–	–	–	–	–	–	–	–	–	–	4	4
indeterminate dark brown	–	–	1	–	1	–	–	–	–	–	–	–	64	66
indeterminate dark gray	–	1	–	1	–	1	–	–	–	–	–	1	119	123

Table 8.9, continued

Chert Type	Arrow points	Dart points	Dart point preform	Perforator	Early- to middle-stage bifaces	Late-stage to finished bifaces	End scraper	Misc. uniface	Spoke shave	Core tool	Edge-modified flakes	Cores	Unmodified flakes	Total
indeterminate light brown	2	1	–	–	5	1	–	–	1	1	7	–	353	371
indeterminate light gray	–	3	–	–	1	–	1	1	–	–	–	–	92	98
indeterminate mottled	–	–	–	–	3	1	–	–	–	–	5	–	103	112
indeterminate red	–	1	–	–	–	1	–	–	–	–	–	–	49	51
indeterminate white	–	–	–	–	–	–	–	–	–	–	–	1	93	94
indeterminate yellow	–	–	–	–	–	–	–	–	–	–	–	–	6	6
Subtotal	2	6	1	1	10	4	1	1	1	1	12	2	883	925
Total	4	10	1	1	11	4	1	1	1	1	16	2	1,140	1,193

(n = 257) identified as specific types. The identifiable cherts predominately consist of Fort Hood Yellow (32.3 percent), Gray-Brown-Green (27.6 percent), and Heiner Lake Blue-Light (7.8 percent). The specimens identified as Heiner Lake Blue-Light are probably from the Manning Mountain area. Light brown, dark gray, mottled, white, and light gray dominate the indeterminate cherts. Most of the light-colored specimens (n = 538) probably represent locally available materials, and they account for 60.9 percent of the indeterminate chert specimens.

Combined Assemblage

As discussed above, all of the artifacts may be grouped for analysis at a broader level, acknowledging that the combined assemblage from all three areas at Firebreak represents a long period and an unknown number of occupation episodes. This consideration aside, the combined assemblage was examined in terms of lithic sourcing. Previous researchers grouped the Fort Hood chert types into a few large geographic provinces called North Fort, Southeast Range, West Fort, and Cowhouse Creek (for examples, see Mehalchick et al. [1999:227–242] and Trierweiler [1996:527–551]). This grouping seemed reasonable at the time because almost all of the chert types were thought to occur only in one province.

The House Creek sample described by D. Boyd (1999) and the Manning Mountain sample described above (see Table 8.6 and Figure 8.11) illustrate many problems with the old province idea, particularly the West Fort and Southeast Range provinces. These studies show that there is much to learn about the true distributions of various chert types on Fort Hood.

For this analysis, it was decided consider the locations where individual chert types are known to occur, both as localized primary outcrops and as secondary materials in larger sample areas. Although the North Fort Hood, West Fort Hood, and Southeast Range provinces were not used, the Cowhouse alluvial province was retained. Figure 8.12 shows the geographic distribution of chert sources in relation to the Firebreak site, and Table 8.10 provides the key for Figure 8.12. This table divides the cherts into four groups. The first group is the named chert types in the Fort Hood typology as previous researchers originally defined it in 1993–1994. This group is composed almost exclusively of primary chert outcrops, or cherts exposed at or in close proximity to the limestone formation in which they naturally occur. Some of these materials occur in very localized areas (e.g., East Range Flat), but other materials occur across a large area (e.g., Fort Hood Yellow).

The second group is the Cowhouse alluvial gravels, secondary cherts that were added to the Fort Hood typology in 1995. The third group is the House Creek sample identified in 1999, which includes eight of the original named chert types that were found in secondary contexts as upland lag gravels on the Killeen surface above House Creek. The fourth group is the Manning Mountain sample described earlier in this chapter, which contained two chert types found as primary cherts on Manning Mountain and secondary cherts on its slopes.

One other caution worth noting might be termed the live fire factor. Because the live fire range sits squarely in the center of Fort Hood and much of it has not been systematically surveyed to locate sites and chert sources, there is a big gap in our knowledge of natural chert distributions. Still, plotting chert sources on a map provides a reasonable indication of how far the Firebreak site is from various sources of chert (see Figure 8.12).

In examining lithic sources, chert sources found within 5 km of the site are considered local, those found from 5 to 15 km away are considered nearby, and those sources more than 15 km away are considered nonlocal. The combined lithic assemblage was then sorted into tools vs. lithic reduction debris and quantified by chert types as shown in Table 8.11. This table provides a great deal of data for specific chert types and will be of interest to many researchers. One crucial point highlighted by these data are that the two dominant types are Cowhouse White and Fort Hood Yellow. Another critical point is that 76 percent of all of the lithic artifacts are indeterminate cherts, but a large portion of these are light-colored cherts that, although they cannot be typed with confidence, are almost certainly local materials. When the detailed data in Table 8.11 are boiled down to a single summary graph, the pattern is clear. Figure 8.13 shows that most of the lithic materials used by the prehistoric inhabitants at Firebreak were obtained from sources very close to the site.

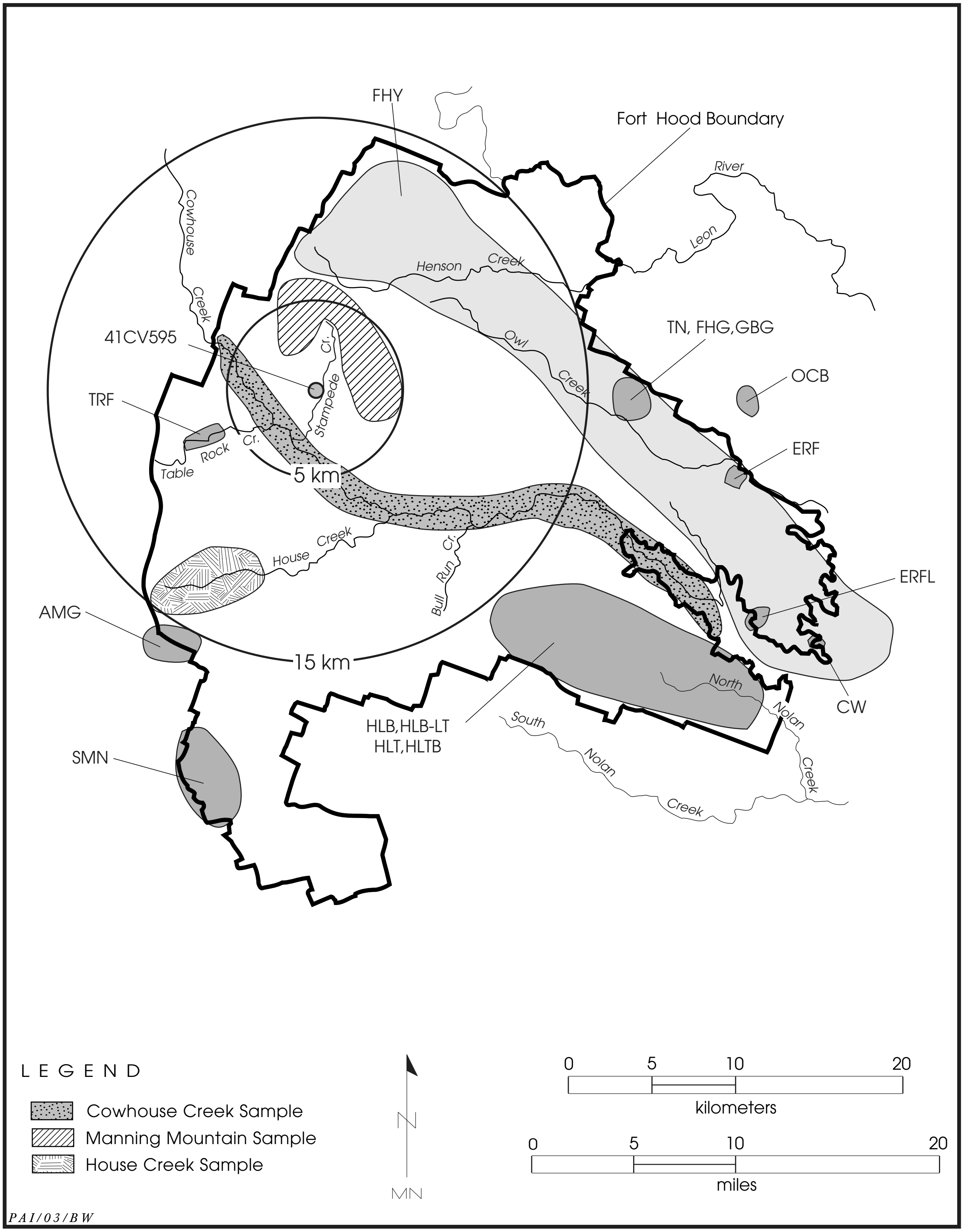

Figure 8.12. Map of Fort Hood showing the locations of chert resources in relation to the Firebreak site (see Table 8.10). Locations of original named chert types are from Frederick and Ringstaff (1994:Figure 6.6).

Table 8.10. Fort Hood chert typology and sample areas used to analyze lithic artifacts from the Firebreak Site

Type Abbreviation	Type Name	References
ORIGINAL NAMED CHERT TYPES		Trierweiler ed. 1994:Appendix C
AMG	Anderson Mountain Gray	Abbott and Trierweiler 1995:709–723,
CW	Cowhouse White	Appendix I
ERF	East Range Flat	Trierweiler 1996:543–551
ERFL	East Range Flecked	
FHG	Fort Hood Gray	
FHY	Fort Hood Yellow	
FPB	Fossiliferous Pale Brown	
GBG	Gray-Brown-Green	
HLB	Heiner Lake Blue	
HLB-LT	Heiner Lake Blue-Light	
HLT	Heiner Lake Tan	
HLTB	Heiner Lake Translucent Brown	
LP	Leona Park	
OCB	Owl Creek Black	
SMN	Seven Mile Mountain Novaculite	
TN	Texas Novaculite	
COWHOUSE ALLUVIAL GRAVEL TYPES		Abbott and Trierweiler 1995:722, Appendix I
CBM	Cowhouse Banded and Mottled	Trierweiler 1996:543–545
CBF	Cowhouse Brown Flecked	
CDG	Cowhouse Dark Gray	
CFLB	Cowhouse Fossiliferous Light Brown	
CLG	Cowhouse Light Gray	
CTT (or CM)	Cowhouse Two Tone (or Mottled)	
CMF	Cowhouse Mottled with Flecks	
CN	Cowhouse Novaculite	
CSH	Cowhouse Shell Hash	
CS	Cowhouse Striated	
HOUSE CREEK SAMPLE		D. Boyd 1999:Table 79
AMG	Anderson Mountain Gray	
CLG	Cowhouse Light Gray	
CTT	Cowhouse Two Tone	
FPB	Fossiliferous Pale Brown	
HLB	Heiner Lake Blue	
HLB - LT	Heiner Lake Blue-Light	
SMMN	Seven Mile Mountain Novaculite	
TRF	Table Rock Flat	
MANNING MOUNTAIN SAMPLE		this report
CW	Cowhouse White	
FPB	Fossiliferous Pale Brown	
–	unnamed light colored and mottled cherts	

Table 8.11. Chert types represented in the chipped stone artifacts from 41CV595 (all areas)

Chert Type	Proximity to Firebreak Site	All Tools		Lithic Reduction Debris		Total	
		Number	Percent	Number	Percent	Number	Percent
Anderson Mountain Gray	nearby	4	3.4	59	1.8	63	1.9
Cowhouse White	local	9	7.6	228	7.0	237	7.0
All Cowhouse alluvial gravels	local	0	0.0	54	1.7	54	1.6
Fort Hood Gray	nonlocal	2	1.7	9	0.3	11	0.3
Fort Hood Yellow	nearby	5	4.2	163	5.0	168	5.0
Fossiliferous Pale Brown	local	0	0.0	10	0.3	10	0.3
Gray-Brown-Green	nonlocal	1	0.8	80	2.4	81	2.4
Heiner Lake Blue and Blue-Light	nearby	5	4.2	81	2.5	86	2.5
Heiner Lake Tan	nearby	1	0.8	0	0.0	1	0.0
Heiner Lake Translucent Brown	nonlocal (could be nearby?)	0	0.0	90	2.8	90	2.7
Owl Creek Black	nonlocal	2	1.7	17	0.5	19	0.6
Seven Mile Mountain Novaculite	nearby	1	0.8	1	0.0	2	0.1
Subtotal of identifiable cherts		30	25.4	792	24.2	822	24.3
indeterminate mottled*	local	20	16.9	269	8.2	289	8.5
indeterminate red	unknown, heat treated	4	3.4	98	3.0	102	3.0
indeterminate light colors**	local	56	47.5	1642	50.2	1698	50.1
indeterminate dark colors	unknown	8	6.8	470	14.4	478	14.1
Subotal of indeterminate cherts		88	74.6	2479	75.8	2567	75.7
Total		118	100.0	3271	100.0	3389	100.0

* Similar to Cowhouse Two Tone (or Mottled), Mottled with Flecks, and Banded and Mottled

** Similar to Cowhouse White and other light-colored cherts in Manning Mountain sample

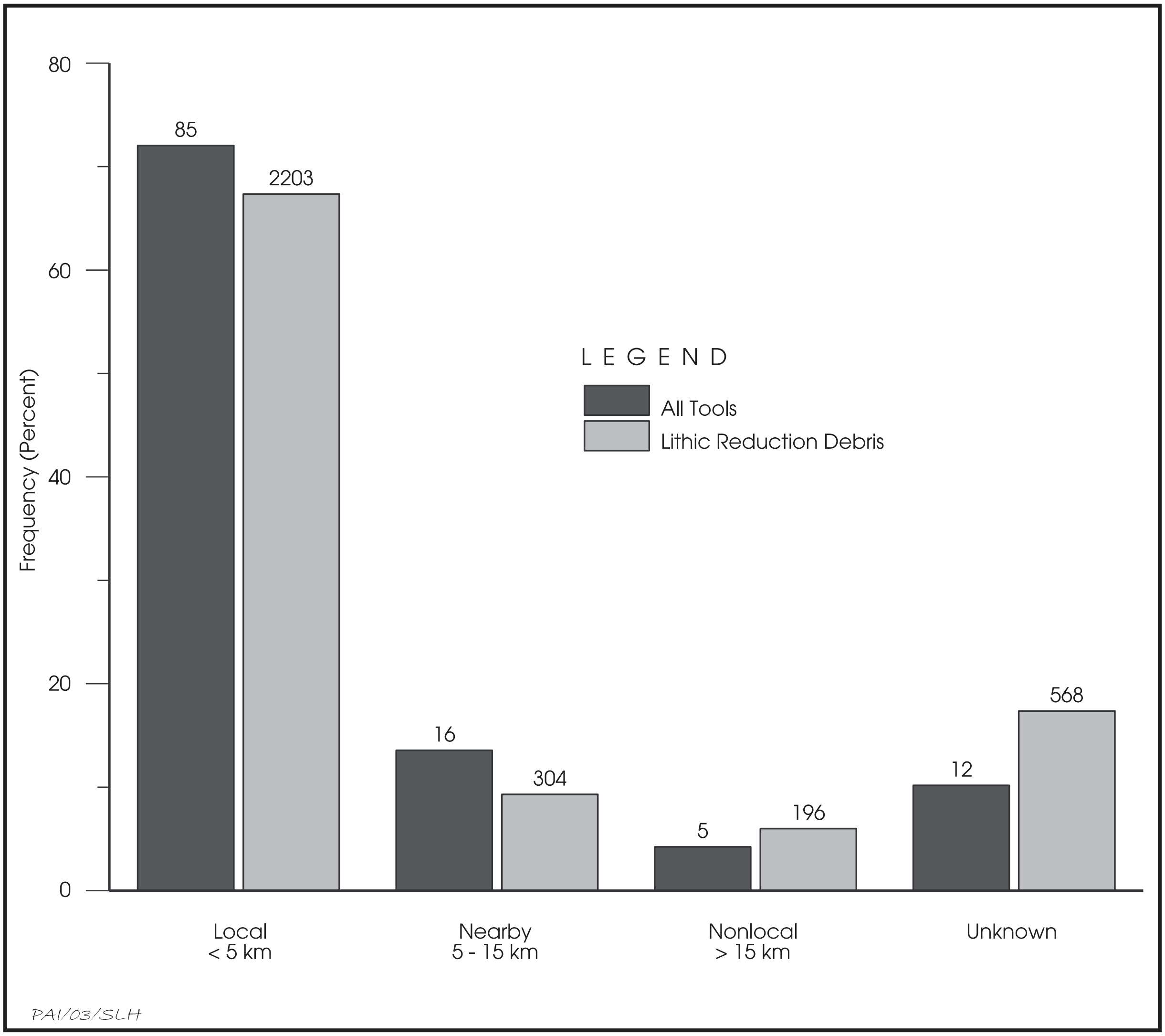

Figure 8.13. Comparison of chert sources in the 41CV595 assemblage by proximity to the site.

Lithic Technology at Firebreak

Part of the analysis of lithic tools and debitage was aimed primarily at defining lithic technology and technological organization. Because the chronological and spatial analyses of lithic artifacts support the premise that the Firebreak assemblage represents materials deposited during many different occupations over hundreds of years, a detailed comparative analysis of changes in technology and organization over time is not possible. Consequently, this discussion separates materials horizontally by area and characterizes the technological aspects of each area's assemblage without attempting to separate materials into temporal components. The discussion then combines the assemblages from all three areas to summarize lithic technology for the whole site.

Area 1

The limited sample recovered from Area 1 is sufficient for only a general characterization of lithic technology. A more thorough qualitative technological assessment of debitage is presented for Areas 2 and 3 because the samples are larger and groups of flakes were recognized as representing lithic reduction episodes (see Tables 8.4 and 8.5). In Area 1, three expedient flake tools and three small multidirectional flake cores represent the chipped stone tools and cores. Both the flake tools and cores appear to have been produced by hard hammer percussion. A large tested cobble with limestone cortex and iron-stained weathering rind also indicates a large piece of chert was transported from a colluvial or bedrock source on Manning Mountain nearly 2 km away.

Based on the variability of chert color, evidence of heating, and presence of dorsal cortex, debitage recovered from the area consists of mixed flakes from several reduction events. A cursory examination of the debitage revealed variability in striking platform morphology, including lipped, multifaceted, and single-faceted. These differences in morphology represent different technological operations, including biface production, flake blank production, and core and platform preparation. Of the 114 pieces of lithic debitage in Area 1, approximately 25 percent show color and luster consistent with heat treating (see heat treatment discussion below).

A single fragmentary metate is the only ground stone artifact recovered from Area 1. The limestone slab on which the metate is made does not appear to have been shaped by intentional breakage or grinding. The concavity and wear polish are most likely produced from continual use as opposed to intentional shaping.

Area 2

Lithic tools and debitage from Area 2 show greater technological diversity than seen in Area 1. Labor intensive tools (n = 34) include projectile points and bifaces, and expediently produced tools (n = 30) include unifaces, scrapers, a spokeshave, burins, and edge-modified flakes. Dart points appear to have been produced by a combination of soft-hammer percussion thinning of flake or bifacial blanks and final thinning and shaping using pressure flaking. In contrast, only pressure flaking was used to produce the arrow point preform. All of the complete and nearly complete projectile points (n = 7) recovered from Area 2 show some degree of maintenance, including pressure resharpening of lateral edges and repair from use-related breakage. One arrow point preform and two dart points show luster consistent with heat treating of chert (see heat treatment discussion below).

The analysis of the bifaces recovered from Area 2 reveal several aspects of lithic technology at the site. All of the bifaces examined were produced by direct hard- or soft-hammer percussion, except for one small, complete biface that appears to have been produced by pressure flaking. Seventeen of the 18 bifaces recovered are fragmentary. Although determining the cause of breaks on bifacial specimens is somewhat subjective and difficult to quantify accurately, these fragments generally consist of lateral breaks consistent with manufacturing failure. An examination of the break surfaces also reveals patination and weathering consistent with the rest of the artifacts' surface, which indicates that all of the biface fragments were broken at the time of (or soon after) deposition, as opposed to postdepositional damage. Four of the specimens show high luster or blush to red color consistent with heat treating (see heat treatment discussion below).

The remaining lithic tools from Area 2 consist of less labor-intensive tool types, including scrapers, unifaces, and a spokeshave, as well as expedient modified-flake tools. The scrapers and unifaces were produced by direct hard- or soft-hammer percussion modification of distal or lateral edges of flake blanks. Unifacial pressure flaking of a flake fragment produced the spokeshave, and both pressure and direct percussion produced the edge-modified flakes. Platform remnants indicate that expedient tools were produced on flake cores (single platform flakes), as well as debitage from biface production (multiplatform flakes).

Cores recovered from Area 2 also yield insight into lithic technology at the site. Most consist of unprepared multidirectional flake cores. All but one of the cores are complete and at or near exhaustion. The relatively high number of flake cores suggests a significant reliance on expedient tool technologies at the site.

The total debitage recovered from Area 2 represents a finite number of reduction activities. Although it certainly does not account for every episode, the 12 identified debitage groups discussed earlier in the chapter (see Table 8.4) may be characterized in lithic technology terms. Of the 12 groups identified, only two appeared to represent core reduction, and the other 10 groups, various stages of biface production. Seven of the 10 biface reduction groups examined (see Table 8.4) depict late-stage biface thinning, and three indicate early-stage reduction.

Area 3

As in Area 2, lithic tools and debitage from

Area 3 demonstrate considerable diversity, expressed in labor intensive tools that show maintenance and expedient tools produced with minimal effort and exhibiting little or no maintenance. Labor intensive tools (n = 31) include projectile points, bifaces, and a perforator, and expediently produced tools (n = 20) include a uniface, a scraper, a spokeshave, a core tool, and edge-modified flakes.

All of the arrow points were produced by bifacial or unifacial thinning and shaping of flake blanks through pressure flaking. Dart points appear to have been produced by a combination of soft-hammer percussion thinning of flakes or bifacial blanks with final thinning and shaping accomplished by pressure flaking. All of the complete and nearly complete projectile points (n = 5) from Area 3 exhibit some degree of maintenance, including pressure resharpening of lateral edges and repair of use-related breakage. Two arrow points and five dart points have luster consistent with heat treatment of chert. One dart point specimen exhibits the remnants of a dull reddish-colored surface of the heat-treated blank juxtaposed with lustrous pressure flake scars (see heat treatment discussion below).

Analysis of the bifaces from Area 3 reveals much about lithic technology that was employed. All of the bifaces were produced by direct hard hammer percussion, soft hammer percussion, or both. One exception is a small, complete biface that appears to have been produced by pressure flaking. Although it was not possible to determine the causes of breaks positively, all of the biface fragments (n = 14) show compound, edge, and lateral breaks consistent with manufacturing failure. The fact that 11 specimens are broken early- to middle-stage bifaces suggests that they were probably discarded because of manufacturing failure. Two of the three broken late-stage to finished bifaces also appear to be manufacturing failures, but the retouched edge of one indeterminate fragment suggests that it was broken during use. Examining the break surfaces revealed that 13 fragmentary bifaces (all but one specimen) had patination and weathering on their break surfaces that was consistent with the patination and weathering across the worked surfaces, indicating that the artifacts were probably discarded when they broke rather than having broken after deposition. The exception is a highly patinated specimen with an unpatinated break surface indicating post-depositional breakage. Six of the bifaces show high luster or reddish colors as evidence of heat treating (see heat treatment discussion below).

The remaining lithic tools from Area 3 consist of less labor intensive tool types that include a scraper, a uniface, and a spokeshave, as well as expedient modified or utilized flake tools. The scraper and uniface were produced by direct hard or soft hammer percussion modification of distal and lateral edges of flake blanks. The spokeshave was made on an existing concavity from a broken piece of chert gravel. Both pressure and direct percussion were used to produce edge-modified flakes. Flake blanks used for these expedient tools were flake cores (single platform), as well as biface production flakes (multiplatform).

As seen in Area 2, the cores recovered from Area 3 consist of unprepared multidirectional flake cores. All are complete and at or near exhaustion. The debitage recovered from Area 3 also represents a limited number of reduction activities. Of the seven debitage groups identified earlier in the chapter (see Table 8.5), three appear to represent core reduction, but the other four groups represent various stages of biface production, both late-stage biface thinning (n = 3) and early-stage reduction.

Combined Assemblage

When the artifacts from all three areas are combined, some overall patterns of lithic technology at the Firebreak site are evident. The validity of these patterns is tempered by the unknown number of occupations over an extended period, but the exercise is useful if certain assumptions are acknowledged. It is likely that the overall assemblage represents a series of general campsite occupations and activities that were similar and repeated many times in the same location rather than a series of very specialized occupations and activities that look generalized in the aggregate. If this assumption is true, then the combined assemblage patterns do have some cultural meaning.

When the labor intensive tools (n = 65) are compared with the expedient tools (n = 53), the numbers are fairly consistent, but almost a half of the labor intensive tools are bifaces in various stages of manufacture and reduction (n = 32). Of 30 fragmentary bifaces, all but one are broken in ways that seem to indicate manufacturing breaks rather than damage from use. The 31 dart and arrow points (see Tables 7.10 and 7.14) may be classified according to completeness as follows:

Completeness	Percentage
Complete	19.4
Nearly complete	19.4
Proximal fragment	35.5
Distal fragment	16.1
Medial fragment	9.6

The high percentage of proximal fragments indicates that broken darts and arrows were brought to the Firebreak site for retooling, where the broken stems were discarded as new points were attached. All 12 of the complete and nearly complete points show some type of resharpening or reworking, and at least one proximal fragment exhibits post-breakage use wear. Many of the points (see Figures 7-1, 7-3, and 7-18) with extensively reworked blade edges may have been used as hafted knives. Much of the bifacial manufacturing may have been geared toward producing dart points for repairing weapons. All of these observations suggest that weapon maintenance was an important activity and reuse of damaged tools was common.

Despite the abundance of lithic sources within a few kilometers of Firebreak, there are relatively few cores and tested cobbles (n = 18), and all of them are extensively used or exhausted. This paucity suggests that only limited amounts of raw chert nodules were brought to the site. When the unmodified flakes are compared by size and amount of dorsal cortex (Table 8.12), the three smallest size classes with no dorsal cortex account for about 83 percent of the total assemblage, which also indicates that late-stage reduction dominated lithic processing. With less than 3 percent of the flakes having significant amounts of dorsal cortex (i.e., more than 50 percent of the dorsal face covered with cortex), it is apparent that most of the cherts brought to the site were already reduced from their cobble forms into early-stage bifaces.

Heat Treatment of Chert at Firebreak

Heat treating significantly improves the workability of some Fort Hood cherts, particularly for percussion biface thinning and pressure flaking (see Frederick and Ringstaff 1994:Table 6.5). Heat treating is an especially useful technique on coarser cherts when high-grade chert is not available for the labor-intensive production of formal tools. Frederick and Ringstaff (1994:156–180) have conducted experimental studies with all of the Fort Hood cherts and described the attributes that are diagnostic of heat treatment. They also have quantified, in a subjective manner at least, what heat treatment does to the workability of each chert type. For all 15 of the original Fort Hood chert types they tested, there was some degree of improvement in workability when the specimens were heated to various temperatures between 96° and 460° C.

The combined chipped stone assemblage from the Firebreak site shows a fairly high frequency of heated specimens that were, in all likelihood, intentionally heated. In the lithic analysis, each specimen was coded as displaying evidence of high-temperature heating, low-temperature heating, or no evidence of heating (see Chapter 4). The high heating is thought to represent accidental burning or discard of materials directly into fires. It is likely that these specimens reached temperatures in excess of 500°C, which can easily be obtained in open fire

Table 8.12. Comparison of unmodified flakes by size and amount of dorsal cortex

	Amount of Dorsal Cortex				
Size Category (inch)	0%	1–50%	50–99%	100	Total
< 0.25	320	2	1	–	323
0.25 to 0.5	1732	148	25	3	1908
0.5 to 1.0	636	176	35	9	856
1 to 1.5	66	75	11	1	153
1.5 to 2.0	3	5	1	–	9
> 2.0	2	2	–	–	4
Total	2759	408	73	13	3253
Percent	84.81	12.54	2.24	0.40	100.00

Note: Shaded area accounts for 82.6 percent of all flakes.

hearths (Black et al. 1998:164–167; Lintz 1989:324–325). Low heating, however, is considered to be evidence of intentional heat treating, and it is likely that temperatures ranged between 100° and 500°C.

The combined data from all three areas at the Firebreak site (Tables 8.13 and 8.14) show that 19.5 percent of the tools and 18.3 percent of the lithic reduction debris were probably heat treated. Furthermore, there appears to be a high correlation between heat treatment and the tool type, as demonstrated by looking at the number of heat-treated chipped stone specimens in the following categories:

Formal Tools	
Arrow points	4 out of 5
Dart points	7 of 26
Bifaces	10 of 34
Expedient Tools	
Unifaces	0 of 7
Edge-modified flakes	1 of 39
Other	1 of 7

These data show that 32 percent of the formal tools were heat treated compared to only 4 percent of the expedient tools.

The unmodified debitage also shows clear patterns indicating which materials were being heat treated. Four chert types that show a high percentage of heat-treated flakes are Anderson Mountain Gray (59.3 percent), Cowhouse Two Tone (36.0 percent), Fort Hood Yellow (43.6 percent), and Gray-Brown-Green (83.8 percent). Most of the indeterminate red flakes (85.6 percent) also appear to be heat treated.

When all of the chipped stone tools and debitage are combined as shown in Table 8.15, the correlation between material type and heat treatment indicates a variety of chert types were heat treated to improve workability. Previous workability experiments by Frederick and Ringstaff (1994) concluded that almost all of the Fort Hood chert types demonstrated improved workability after heat treating. Even types that demonstrated good workability in their natural state, such as Fort Hood Yellow and Gray-Brown-Green showed improved workability in late-stage soft hammer percussion and pressure biface thinning after heating (Frederick and Ringstaff 1994:168–176).

Thus, it appears that heat treatment was not employed solely to improve the general workability of low-quality raw materials. Rather, heat treating seems to have been done on all cherts when the intent was to produce specific tool forms, notably thin bifaces and projectile points. The high frequency of heat-treated bifaces and projectile points—compared to other tool types from the site—supports this theory. Also, of the four debitage groups identified in Areas 2 and 3 (see Tables 8.4 and 8.5) as heat treated, all were classified technologically as representing biface reduction events.

Considering the archeological data and the previous experimental data, the analysis results suggest that the inhabitants of the Firebreak Site used heat treating specifically to improve workability in percussion and pressure biface thinning to create formal tools such as projectile points and bifacial knives.

Functional Interpretations of the Firebreak Assemblage

Analyzing artifacts recovered from 41CV595, all of which are stone, allows a limited interpretation of site function based on the assumption that the lithic tool assemblage is an accurate indicator of the activities that took place and, in the aggregate, of overall site function. Unfortunately, two factors limit interpretations of site function based on the lithic assemblage. The inferences of tool function are based primarily on tool type and morphology because no microwear studies were conducted. Such studies may be productive, but meaningful interpretations of tool function are difficult to support and often controversial (see Odell 2001:50—56). Also, because discrete temporal components could not be segregated, it is impossible to identify the functional composition of a lithic assemblage at any one particular time or examine assemblage changes over time. Assuming that the repeated occupations at Firebreak were similar in scope and nature during the Late Archaic and Late Prehistoric periods, however, a closer look at the assemblage is revealing.

Twenty different chipped, ground, and battered stone artifact types are represented in the lithic assemblage from the Firebreak site (Table 8.16). Although the tool assemblage is relatively small (n = 123), the diversity of tasks represented is broad and probably includes weapon maintenance, formal and expedient tool produc-

Table 8.13. Summary of heating evidence observed on chipped stone tools from the Firebreak site

Artifact Group	Chert Type	High Heating (unintentional)	Low Heating (intentional)	No Heating	Total
Arrow points (includes preform)	Fort Hood Yellow	–	3	–	3
	indeterminate light brown	–	1	1	2
Dart points (includes preform)	Anderson Mountain Gray	1	–	–	1
	Cowhouse White	–	1	–	1
	Fort Hood Gray	–	1	1	2
	Fort hood Yellow	–	–	1	1
	Heiner Lake Blue	–	–	1	1
	Heiner Lake Tan	–	1	–	1
	Owl Creek Black	1	–	1	2
	Seven Mile Mountain Novaculite	–	–	1	1
	indeterminate dark brown	–	–	1	1
	indeterminate dark gray	1	1	1	3
	indeterminate light brown	–	1	2	3
	indeterminate light gray	–	1	3	4
	indeterminate mottled	1	–	1	2
	indeterminate red	1	–	–	1
	indeterminate white	–	1	1	2
Perforator	indeterminate dark gray	–	–	1	1
Early- to middle-stage bifaces	Anderson Mountain Gray	–	1	1	2
	Cowhouse White	–	–	1	1
	indeterminate dark brown	–	1	–	1
	indeterminate light brown	–	4	3	7
	indeterminate light gray	–	–	3	3
	indeterminate mottled	–	–	3	3
	indeterminate red	–	–	1	1
	indeterminate white	–	–	3	3
Late-stage to finished bifaces	Cowhouse White	–	1	–	1
	Heiner Lake Blue	–	–	1	1
	indeterminate dark gray	–	–	1	1
	indeterminate light brown	–	–	1	1
	indeterminate light gray	–	–	1	1
	indeterminate mottled	–	–	2	2
	indeterminate red	–	2	–	2
	indeterminate white	–	–	2	2
Miscellaneous biface	indeterminate light gray	–	1	–	1
End scrapers	Cowhouse White	–	–	1	1
	indeterminate light gray	–	–	1	1
Side scraper	indeterminate mottled	–	–	1	1

Table 8.13, continued

Artifact Group	Chert Type	High Heating (unintentional)	Low Heating (intentional)	No Heating	Total
Miscellaneous unifaces	indeterminate light brown	–	–	1	1
	indeterminate light gray	–	–	2	2
	indeterminate mottled	–	–	1	1
Spokeshaves	indeterminate light	–	–	1	1
	indeterminate light gray	–	–	1	1
Graver/Burins	Heiner Lake Blue	–	–	1	1
	indeterminate light brown	–	1	–	1
	indeterminate white	–	–	1	1
Core tools	indeterminate light	–	–	2	2
Edge-modified flakes	Anderson Mountain Gray	–	–	1	1
	Cowhouse White	–	–	5	5
	Fort Hood Yellow	–	–	1	1
	Gray-Brown-Green	–	–	1	1
	Heiner Lake Blue	–	–	1	1
	Heiner Lake Blue-Light	–	–	1	1
	indeterminate dark gray	–	–	1	1
	indeterminate light brown	–	1	9	10
	indeterminate light gray	–	–	4	4
	indeterminate mottled	–	–	11	11
	indeterminate white	–	–	3	3
Total		5	23	90	118
Percent		4.24	19.49	76.27	

tion, hide processing, and plant processing. The discarded projectile points (n = 31), many of which are broken or reworked, represent more than 25 percent of the entire tool assemblage, which suggests significant maintenance of hunting gear—an activity that Binford (1979:263, 267) associates with residential camps. A full 36 percent of the tool assemblage, however, is expedient tools (n = 44) that were presumably used as simple cutting and scraping implements. Their precise functions are uncertain, but microscopic use-wear studies on simple flake tools from other central Texas archeological sites suggest they were commonly used for working a wide array of materials such as wood, medium to soft vegetal materials, and hides (Decker et al. 2000:271–277; Kay et al. 1998). It may be speculated that the expedient flake tools at Firebreak were used for a variety of activities, and some portion of them may have been used in plant processing activities (see Wild Plant Gathering and Processing below).

Broken and discarded early-, middle-, and late-stage bifaces account for 26 percent of the total tools recovered from Firebreak. Of these 32 specimens, 31 appear to be discards because of manufacturing failure, indicating that labor-intensive formal tools were produced on site. The presence of 17 multidirectional flake cores, most of which were at or near exhaustion, also signifies considerable production of expedient flake tools. Unlike formal tools, which were maintained and curated, expedient tools generally were made and discarded as needed (Bettinger 1991:69). The presence of late-stage manufacturing failures and exhausted cores in lithic assemblages is considered an important characteristic for differentiating residential camps from lithic procurement sites (Houk et al. 1997:8).

The 3,253 pieces of lithic debitage recovered from Firebreak represent a variety of lithic reduction activities. Based on the cursory technological analysis of the debitage groups identified

Table 8.14. Summary of heating evidence observed on lithic reduction materials from the Firebreak site

Artifact Group	Chert Type	High Heating (unintentional)	Low Heating (intentional)	No Heating	Total
Cores	indeterminate dark gray	–	–	1	1
	indeterminate light brown	–	–	2	2
	indeterminate light gray	–	–	3	3
	indeterminate mottled	–	–	2	2
	indeterminate red	–	1		1
	indeterminate white	–	–	8	8
Tested cobble	indeterminate light brown	–	–	1	1
Unmodified debitage	Anderson Mountain Gray	3	35	21	59
	Cowhouse Dark Gray	–	–	17	17
	Cowhouse Mottled with Flecks	–	–	2	2
	Cowhouse Novaculite	–	–	1	1
	Cowhouse Streaked	–	–	2	2
	Cowhouse Two Tone	–	2	30	32
	Cowhouse White	–	82	146	228
	Fort Hood Gray	–	–	9	9
	Fort Hood Yellow	4	71	88	163
	Fossiliferous Pale Brown	–	–	10	10
	Gray-Brown-Green	3	67	10	80
	Heiner Lake Blue	3	3	45	51
	Heiner Lake Blue-Light	–	3	27	30
	Heiner Lake Translucent Brown	–	2	88	90
	Owl Creek Black	3	–	14	17
	Seven Mile Mountain Novaculite	–	–	1	1
	indeterminate black	3	–	6	9
	indeterminate dark brown	9	27	75	111
	indeterminate dark gray	51	9	289	349
	indeterminate light brown	11	145	759	915
	indeterminate light gray	35	14	342	391
	indeterminate mottled	16	41	210	267
	indeterminate red	10	83	4	97
	indeterminate white	–	13	302	315
	indeterminate yellow	–	–	7	7
Total		151	598	2,522	3,271
Percent		4.62	18.28	77.10	

in Areas 2 and 3 (see Chapter 7), most of the materials are attributed to late-stage biface production, with lesser amounts of debitage indicating core reduction and early-stage biface reduction. The abundance of small flakes with no dorsal cortex remaining on the unmodified flakes (see Table 8.12) also hints at late-stage biface reduction along with final production and maintenance of formal tools.

The presence of the two end scrapers and one side-scraper suggests hide processing at the Firebreak site. Although unifacial scrapers can be used for a variety of tasks, they were commonly used for hide scraping, and this is especially true for certain forms of end scrapers. One of the end scrapers from Firebreak (see Figure 7.32) is a distal fragment that may have broken off of a planoconvex end scraper (also called dorso, Plains-style, or turtle-back end scrapers). It is well documented, both ethnographically and archeologically, that similar end scrapers were used for hide scraping (primarily buffalo) all across the Great Plains and were usually hafted onto antler or wooden handles (e.g., Bement and Turpin 1987; Hughes 1991; Metcalf 1970; Wedel 1970). In central and south Texas, planoconvex

Table 8.15. Summary of heating evidence observed on all chipped stone tools and lithic reduction materials from the Firebreak site

Chert Type	High Heating (unintentional)	Low Heating (intentional)	No Heating	Total	Percent Intentionally Heat-Treated
Anderson Mountain Gray	4	36	23	63	57.14
Cowhouse Dark Gray	–	–	17	17	–
Cowhouse Mottled with Flecks	–	–	2	2	–
Cowhouse Novaculite	–	–	1	1	–
Cowhouse Streaked	–	–	2	2	–
Cowhouse Two Tone	–	2	30	32	6.25
Cowhouse White	–	84	153	237	35.44
Fort Hood Gray	–	1	10	11	9.09
Fort Hood Yellow	4	74	90	168	44.05
Fossiliferous Pale Brown	–	–	10	10	–
Gray-Brown-Green	3	67	11	81	82.72
Heiner Lake Blue	3	3	49	55	5.45
Heiner Lake Blue-Light	–	3	28	31	9.68
Heiner Lake Tan	–	1	–	1	100.00
Heiner Lake Translucent Brown	–	2	88	90	2.22
Owl Creek Black	4	–	15	19	–
Seven Mile Mountain Novaculite	–	–	2	2	–
indeterminate black	3	–	6	9	–
indeterminate dark brown	9	28	76	113	24.78
indeterminate dark gray	52	10	294	356	2.81
indeterminate light brown	11	153	782	946	16.17
indeterminate light gray	35	16	360	411	3.89
indeterminate mottled	17	41	231	289	14.19
indeterminate red	11	86	5	102	84.31
indeterminate white	–	14	320	334	4.19
indeterminate yellow	–	–	7	7	–
Total	156	621	2,612	3,389	18.32

Note: Low-temperature heating is assumed to be evidence of heat treating.

end scrapers are associated with other periods, such as the Late Archaic, but they are most often associated with Toyah phase occupations. In fact, Bement and Turpin (1987:191) consider planoconvex end scrapers to be a "defining characteristic of the Toyah phase, ca. A.D. 1350–1750, in Central Texas." Morphological, use wear, and organic residue studies on Toyah phase scrapers from central Texas support the notion that they were hide-working tools (Black 1986:78–85; Johnson 1994:117–138; Loy 1994:609; Quigg and Peck 1995: 92–98, 168).

Grinding tools represent only 3 percent of the stone tool assemblage from Firebreak. The two metates and two pitted nutting stones almost certainly represent plant processing activities. A considerable amount of evidence linking these grinding tools to plant processing supports this inference (e.g., Schlanger 1991; Turner and Hester 1993:308–309). Recovery of probable low-fat plant residues from the basin of the complete metate (see Figure 7.21) and macrobotanical remains from earth ovens suggest a relationship between grinding and cooking wild onion and camas bulbs. Evidence also indicates that pecan nuts and acorns were crushed in the pitted stones and suggests a possible relationship with earth oven cooking (see Wild Plant Gathering and Processing).

Clearly, the stone artifact assemblage from Firebreak indicates a residential base camp where a wide variety of activities occurred. Resi-

Table 8.16. Summary of stone tools and lithic reduction debris from the Firebreak site

Artifact Class	Artifact Category	No. of Specimens	% of Stone Tools by Category	Artifact Group	No. of Specimens	% of Stone Tools by Group
Chipped stones	Formal tools	65	52.85	Arrow points	3	2.44
				Dart points	25	20.33
				Point preforms	3	2.44
				Perforator	1	0.81
				Early to middle-stage bifaces	21	17.07
				Late-stage to finished bifaces	11	8.94
				Miscellaneous biface	1	0.81
	Expedient tools	53	43.09	End scrapers	2	1.63
				Side scraper	1	0.81
				Miscellaneous unifaces	4	3.25
				Edge-modified flake	39	31.71
				Spokeshaves	2	1.63
				Burins	3	2.44
				Core tools	2	1.63
	Lithic reduction debris	3271*	–	Cores	17*	–
				Tested cobble	1*	–
				Debitage	3253*	–
Ground stones		4	3.25	Metates	2	1.63
				Pitted stones	2	1.63
Battered stones		1	0.81	Hammerstone	1	0.81
Total tools		123	100.00		123	100.00

* Numbers excluded from tool count.

dential base camps are a component of both forager and collector subsistence strategies as defined by Binford (1980) and Bettinger (1991), and it is somewhat difficult to fit a single site into these models. The overall intensity of human activities at Firebreak (as expressed by features and artifacts) is extremely low, however, compared to the total time span during which the site was occupied. The artifacts must be viewed together as an assemblage of cultural materials that accumulated over some 2,000 years (from ca. 790 B.C. to A.D 1263) on a relatively stable, slowly aggrading surface. When considered from this perspective, the assemblage suggests that Firebreak functioned as a temporary or short-term residential camp during many sporadic occupations, most likely by small bands of foragers (see Chapter 9).

SUBSISTENCE TECHNOLOGIES AND RESOURCES

Animal Hunting and Processing

Vertebrate remains are sparse, with only 15 bone fragments recovered. One bone is an armadillo ulna, an obvious modern intrusion because they only recently migrated to Texas (Davis 1974:267). All others are unidentifiable or represent canid- to deer-sized animals, but some bones are burned or have spiral fractures. Although the bones are a clear indication of hunting, poor preservation almost certainly biases the sample to some extent. The projectile points and formal scraping tools are the strongest indicators of hunting activities, but it is impossible to determine how important hunting activities actually were to the people who lived at Firebreak. The evidence indicates that people were concerned with retooling their weapons while they were there. Even if they did not do much hunting while living at the site, retooling implies that hunting was an important component of their lifestyles. Hunting is generally a male-oriented activity, and the hunters were concerned with repairing their personal gear while living in a residential camp (Binford 1979:263). When compared with the evidence for plant processing, it seems reasonable to suggest that hunting may have been a relatively low key or opportunistic activity for people living at Firebreak.

Shellfish Gathering and Processing

Only limited numbers of fragmented mussel shell umbos were recovered. Only one specimen (from Area 2) was identifiable–an *Amblema plicata* (threeridge), a common species over most of central Texas. This species can tolerate shallow (from 1.5 to 1.5 m deep) and low-quality water in lakes and streams, and these mussels can survive droughts by burrowing into the mud (Howells et al. 1996:34). Threeridge mussels would have been easy to gather along the larger streams such as Cowhouse Creek, which is only 3 km southeast of the Firebreak site. It also is possible that these mussels were obtained from Stampede Creek just east of the site, but this minor stream would probably have supported smaller mussels than the larger streams.

There are many sites where mussel shells are ubiquitous and may represent important food items, but these locations are almost always situated near major streams. On Fort Hood, sites along Cowhouse Creek (e.g., 41BL339, 41CV95, and 41CV97) and the Leon River (e.g., 41CV580, 41CV1480, and 41CV1482) represent localities where mussels were harvested and consumed (Abbott and Trierweiler 1995a:780; Mehalchick, Killian, et al. 2000; Mehalchick et al. 2001). Dense clusters and lenses of mussel shells, some associated with burned rock features, appear to represent waste piles of discarded shells, but a few shells found in these contexts show modification indicating tool or ornamental use.

Shell analyses identified six to eight separate species at four of the six sites, but there was no attempt to quantify the remainsat 41CV1480 and 41CV1482. The identified species are known to be able to withstand a range of flow conditions and habitats, suggesting that the mussels were collected from different places within the streams. Other sites in central and west-central Texas have produced similar types of shell concentrations and appear to represent intensive use of fresh water mussels. Examples include the Elm Creek site (41CN95) along the Colorado River at O. H. Ivie Reservoir and 41TG91 along the South Concho River. Cultural Unit 2 at the Elm Creek site yielded considerable amounts of mussel shells that were apparently heated (or steamed) to extract the mussels, and many were associated with an incipient burned rock midden of Late Prehistoric age (Treece et al. 1993b:380, 386). Stratified Late Archaic cultural deposits at 41TG91 yielded large quantities of mussel shells. Many large and small shell clusters are described, and researchers suggested that the shells were roasted or boiled to extract the mussels (Creel 1990:69–87, 211–213).

The evidence from Firebreak demonstrates that fresh water shellfish were being harvested, probably as food, but that this activity was of very minor importance while the people were actually at Firebreak. It is possible that the shells were being brought to the site as tools or ornaments rather than live mussels being harvested for food. The use of mussel shells to manufacture ornaments in prehistoric times is well documented in Texas (e.g., Howells et al. 1996:23; Lintz 1992).

Wild Plant Gathering and Processing

Direct and indirect evidence substantiates plant gathering and processing as the primary activities conducted at the Firebreak site. Abundant macrobotanical remains were recovered from flotation samples, with 93.2 g of charred plant materials representing 16 identifiable woods and 4 taxa of edible plant resources (see Appendix B). Charred remains of four edible plants were recovered in Area 2 (Table 8.17). They were found in association with the earth oven features and the burned rock layer that probably represents residue discarded from cleaning out earth ovens. All of these resources—oak acorns, pecans, wild onions, and eastern camas—were probably important foods, if not staples that made up a significant portion of the diets of prehistoric inhabitants at the Firebreak site.

Charred plant remains found at four other Paluxy sites on Fort Hood are interpreted as representing food resources. Indeterminate thick and thin nutshell fragments were found at 41CV947, indeterminate geophyte corm fragments were found at 41CV988, and indeterminate thick nutshell fragments (possibly walnut) were found at 41CV1093 (Dering 1999c:Table 113; Kleinbach et al. 1999:65, 77–78, 100). Site 41CV1553 has yielded the greatest variety of edible floral remains, consisting of indeterminate bulbs and fragments of oak acorns, and nutshells of pecan, hickory, and walnut (Mehalchick, Killian et al. 2000).

Four large basin-shaped, rock-lined pit features (Features 4, 8, 11, and 15) are similar in morphology and have been interpreted as earth ovens for cooking plant foods. The fill associated with Feature 15 yielded many charred eastern camas bulbs recovered from flotation of sediments just above, inside, and below the rock-lined pit. Charred bulb fragments of wild onion and eastern camas were recovered from the general burned rock scatter found around the earth ovens.

Features 8 and 11 did not produce any charred remains of root storage parts, but they did yield charred oak acorn fragments, and pecan nutshell fragments were also found in Feature 11. The fact that there were no edible plant foods in the charred materials from earth oven Feature 4 could be related to functional differences (i.e., Feature 4 was used for a different type of cooking or cooking different foods) or poor preservation. Because of the paucity of charred woods in this earth oven, it is perhaps more likely that circumstances caused the charred remains to be poorly preserved. Perhaps earth oven Features 8, 11, and 15 were quickly backfilled or covered over after the last use, but the Feature 4 pit was left open for an extendedperiod, allowing the burned remains to deteriorate.

Geophytes

Eastern camas and wild onions are both perennial bulb-bearing plants of the Liliaceae or lily family. They are classified as geophytes, a botanical group in a taxonomy that divides plants according to the location of their perennating tissues (the parts that live from season to season and through the winter). According to Raunkiaer (1934:64), geophytes are defined as "land plants whose surviving buds or shoot-apices are borne on subterranean shoots at a distance from the surface of the ground." This simply means that geophytes have overwintering food storage organs that are underground. The underground food storage organs of geophytes are grouped into five different classes, defined by Thoms (1989:Table 2) as:

Bulb	An underground leaf bud with fleshy scales or coats (i.e., basal portion of leaves are thickened), as in the common onion (*Allium cepa*)
Corm	An enlarged (i.e., swollen) base of a stem, bud-like in appearance but solid as in taro (*Colocasia esculenta*)
Rhizome	A horizontally creeping stem, usually enlarged, with roots emanating from nodes on the bottom side and buds from the leaf axil on the upper side, as in arrowroot (*Maranta arundinacea*)
Taproot	A fleshy, thickened vertical root that continues the main axis of the plant, as in the common carrot (*Daucus carota*)
Tuber	A thickened and short underground branch or the swollen tips of stems having numerous buds, as in the Irish potato (*Solanum tuberosum*) and manioc or cassava *(Manihot utilissma*)

Although many geophytes have food storage organs that are edible with little or no processing, others are mildly to very toxic because they contain alkaloids. Cooking geophytes slowly in earth ovens is one way of removing alkaloids to make some plants edible or more palatable (Dering 1994; Dering 1996; Dering 1999a; Dering 2001a; Diggs et al. 1999:1191; Wandsneider 1997). Cheatham and Johnston (2000:516) note that steaming or boiling various species of *Camassia*, including *C. scilloides*, produces a hydrolytic process that converts the complex carbohydrates to sugars. Malouf (1979:39) also reports that pit baking of camas results in a sugar-rich product.

Wandsneider (1997) provides the most succinct discussion of how heat treatment affects

Table 8.17. Edible plants recovered, Area 2, 41CV595

Plant	Plant Part	Context	Season of Food Availability	References
Eastern camas (or wild hyacinth) *Camassia scilloides*	bulbs	General, burned rock layer	March–June	Cheatham and Johnston 2000:514–528
		Feature 15, earth oven		Diggs et al. 1999:1198–1200
Wild onion *Allium canadense*	bulbs	General, burned rock layer	All year but primarily April–May	Cheatham and Johnston 1995:206–229
				Diggs et al. 1999:1194–1198
Oak *Quercus* sp.	acorn shell (pericarp) fragments	Feature 8, earth oven	September–November	Vines 1986:147–198
		Feature 11, earth oven		
Pecan *Carya illinoiensis*	nut shell fragments	Feature 11, earth oven	September–November	Vines 1986:127

food chemistry, with a particular emphasis on the unique relationship between pit baking and plants that contain various types of complex carbohydrates that are not easily digested or are toxic. Heat treatment can change the chemistry of many types of foods, and its effects are desirable in many cases.

For many different plant foods, heating converts the carbohydrates into sugars through a process called hydrolysis. Wandsneider observes how heating affects various types of plant and animal foods, and many of the plants she considers are geophytes. Plants in the lily (Lilaceae) and agave (Agavacae) families contain fructan, a specific type of reserve carbohydrate that contains a polymer of fructose and glucose (the latter are simple sugars). Fructan, or its more common form called inulin, may be chemically altered through heating. The chemistry is quite complex and depends on many different variables, but the simple explanation is that heating fructan-containing plants breaks down the fructan into easily digestible fructose and glucose. For this to occur, the plants must be cooked for long periods at relatively high temperatures. This effect is easily achieved in earth ovens, which have the added advantage of maintaining a moist cooking environment if moist materials such as prickly pear pads or wet grass are added. The moist cooking environment is important, not only so that the food plants do not dehydrate and burn, but steaming also promotes hydrolysis.

Although past hunter-gatherer peoples may not have understood the chemistry, they certainly understood the relationship between heating and the palatability and taste of the foods they ate. Wandsneider (1997) discusses a considerable body of ethnographic evidence that demonstrates how pit baking was used to mass produce specific plant foods in many parts of the world. In her study, Wandsneider (1997:24) concludes:

> In sum, pit-hearth processing of plant tissues is predominantly associated with mass processing of inulin-rich plant parts. By harvesting and pit-processing such foods, people were able to take advantage of an intensifiable and storable energy source that thrived in areas with few other intensifiable resources. Indeed, Thoms (1989) emphasizes the degree to which camas fields were managed and exploited in the American Northwest, and, in the American Southwest, Fish and colleagues (1990) have documented extensive mulch fields that apparently supported agave….

It is particularly notable that most of the fructan-containing and inulin-rich plants that Wandsneider (1997:Tables 1a and 1b) mentions are, in fact, geophytes.

The use of earth ovens for cooking various foods is well documented ethnographically, especially among hunter-gatherers who cooked camas in the Pacific Northwest (Hunn and

French 1981; Storm 2002; Thoms 1989; Wandsneider 1997) and agave in the Southwestern United States (Dering 1888b, 1999a; Ellis 1997; Wandsneider 1997). Using the Human Resources Area File and other ethnographic sources, Wandsneider (1997:Appendixes 1–3) compiled data on 110 examples of pit-hearth cooking from around the world. By noting what animal and plant foods were being cooked by various peoples, she concluded that earth ovens were primarily used for preparing plant foods. Wandsneider (1997:Figure 3, Table 8) shows that pit-hearths were used to cook different foods in the following frequencies:

Food Type	**Percent**
Plant only	77.3
Animal only	17.3
Mixed	5.4

She goes on to show that of all ethnographic examples of pit-hearths used exclusively for cooking plants, some 78 percent of the plants were high carbohydrate plants (containing inulin and fructan), and bulbs, roots, and tubers of geophytic plants compose the bulk of them.

Finding camas and wild onions in earth ovens at the Firebreak site represents an important discovery that adds to the growing list of geophyte root parts found at prehistoric sites in central and southeast Texas (Table 8.18). These finds now include four species and appear to represent a widespread pattern of geophyte processing and use. Notably, two important things have occurred in the past decade or so that make it possible to identify such fragile plant remains in prehistoric contexts. First, although the use of flotation techniques to recover charred plant remains has been around for a long time, it has only recently become customary to take large amounts of sediment for processing and analysis. In short, the more feature fill you float, the better your chances of recovering identifiable plant remains. Second, although prehistoric charred onion bulbs were identified years ago at Kyle Rockshelter (Jelks 1962:Table 114) and Horn Shelter (Watt 1978:119), those were whole or nearly complete bulbs, and it was not until recently that ethnobotanists were able to identify tiny fragments of charred bulbs. In 1994, Dr. Phil Dering recognized bulb fragments from prehistoric features but could not identify any of them to species (Dering 1994). Later experiments by Dering (1999) laid the groundwork that allows certain species (see Appendix B) to be identified through microscopic examination of small bulb fragments. It is likely that many more interpretive breakthroughs will be made through continued intensive sampling and flotation of archeological sediments, as well as extensive botanical sampling and experimentation.

Acorns and Pecans

Prehistoric and historic use of two major food resources of central and south Texas—oak acorns and pecan nuts—are documented archeologically and ethnographically (e.g., Black et al. 1997; Creel 1986, 1991; Ellis 1997; Hall 2000; Hester 1991; Jackson 1991). Charred remains of pecan nutshell and oak acorn fragments were found in sufficient quantities to indicate that people living at the Firebreak site gathered and processed these foods on site. This also suggests that a substantial number of oak and pecan trees were available in close proximity, probably within a few kilometers of the site.

Almost all types of oak produce edible acorns, but some require more processing than others because they have high levels of tannin. The charred oak remains from the Firebreak site are assigned only to the genus level. There are eight oak species that grow on Fort Hood today (Laura Sanchez, personal communication 2000), and they consist of four species of white oaks—bur, chinquapin, live, and shin—and four species of black (or red) oaks—blackjack, post, Texas red, and Shumard's. The senior field botanist at Fort Hood, Laura Sanchez, and PAI archeologist Gemma Mehalchick identified four species of oak growing on and close to Paluxy sands during the spring of 1997 (Kleinbach et al. 1999:389, Table 86). They looked at four Paluxy localities (sites 41CV947, 41CV984, 41CV988, and 41CV1049) and identified these species:

Quercus buckleyi	Texas red oak
Quercus marilandica	blackjack oak
Quercus stellata var. stellata	post oak
Quercus virginiana	live oak

Most oaks are well adapted to calcareous rocky soils or deep floodplain deposits, but the researchers noted that two species–blackjack and post oaks–seemed to be growing directly in the Paluxy sands but not in the thin soils that overlay the Walnut Clay (upslope) or Glen Rose limestones (downslope). At the Firebreak site,

Table 8.18. Archeological finds of charred geophyte root parts (bulbs, corms, and tubers) in central and southeast Texas*

County	Site Name (No.)	References for Geophyte Identification	Estimated Age of Geophyte Occurrences** (Years, B.P.)	Archeological Context and Basis for Age Estimate	Unidentified bulb	Unidentified corm or rhizome	Unidentified root storage part	Unidentified tubers (cf. *Pediomelum* sp.)	Lily family bulb (Lilaceaea, includes wild onion and garlic)	Wild Hyacinth or Eastern Camas bulb (*Camassia scilloides*)	Wild Onion bulb (*Allium canadense* and *Allium* sp.)	False Garlic bulb (*Nothoscordum bivalve*)	Dog's Tooth Violet bulb (*Erythronium* sp.)	Rain Lily bulb (*Cooperia drummondii*)
Bell	Unnamed rockshelter (41BL797) on Fort Hood	Dering 2003a	1510 ± 50	Unidentified bulb from a burned rock midden (Feature 1). Radiocarbon date is on Feature 1 (Mehalchick, Killian, Caran et al. 2000).	X	–	–	–	–	–	–	–	–	–
Bosque	Horn Shelter No. 1 (41BQ47)	Phil Dering, personal communication 2001; Watt 1978	510 ± 30	Sixty-five wild onion bulbs were found in a probable baking pit feature found near the top of a burned rock midden. This feature represents one of the latest activities at the shelter and is buried by a 36-inch layer of flood deposits (Watt 1978:119). The radiocarbon date is stated as being an assay on "carbonized onion seeds" (Watt 1978:119), but they are actually bulbs that Phil Dering has examined and identified.	–	–	–	–	–	–	X	–	–	–
Brown	Eight burned rock midden sites at Camp Bowie	Dering 2002b	Unspecified	Hundreds of bulb fragments and one corm fragment were found in earth oven features at eight burned rock midden sites (not yet reported). Eastern camas bulbs were found in six sites; Wild onion bulbs were found in three sites; and dog's tooth violet bulbs were found in one site (Dering 2002b).	X	X	–	–	–	5X	3X	–	X	–

Table 8.18, continued

County	Site Name (No.)	References for Geophyte Identification	Estimated Age of Geophyte Occurrences** (Years, B.P.)	Archeological Context and Basis for Age Estimate	Unidentified bulb	Unidentified corm or rhizome	Unidentified root storage part	Unidentified tubers (cf. *Pediomelum* sp.)	Lily family bulb (Lilaceaea, includes wild onion and garlic)	Wild Hyacinth or Eastern Camas bulb (*Camassia scilloides*)	Wild Onion bulb (*Allium canadense* and *Allium* sp.)	False Garlic bulb (*Nothoscordum bivalve*)	Dog's Tooth Violet bulb (*Erythronium* sp.)	Rain Lily bulb (*Cooperia drummondii*)
Caldwell	Armstrong (41CW54)	Dering 2002b	6780 ± 60	Two camas bulbs from a burned rock cluster (Feature 2) in Early Archaic occupation Zone 3 (Schroeder and Oksonen 2002:62,269).	–	–	–	–	–	X	–	–	–	–
Coryell	Firebreak Site (41CV595)	this report	2180 to 1050 1910 ± 70 on Feature 15	Four onion and 69 camas bulbs were found in features in Area 2. Age is total span of eight radiocarbon dates from Area 2 features, including one charcoal assay from Feature 15, which produced 40 camas bulbs (this report).	–	–	–	–	–	X	X	–	–	–
Coryell	Unamed open campsite (41CV117) on Fort Hood	Dering 1996	unknown	Unidentified lily family bulb fragments recovered from burned rock midden (Feature 1) deposits (Trierweiler 1996:223-233). Deposits are of Middle and Late Archaic age.	–	–	–	–	X	–	–	–	–	–
Coryell	Unamed Paluxy site (41CV988) on Fort Hood	Dering 1999c	1280 ± 40	Unidentified corm fragments (n=14) from a hearth (Feature 2A).	–	X	–	–	–	–	–	–	–	–
Coryell	Unnamed Paluxy site (41CV1553) on Fort Hood	Dering 2000b	240 ± 50	Two unidentified bulbs from Feature 3, a large hearths or earth oven (Mehalchick, Killian, Caran, et al. 2000). Radiocarbon date on Feature 3.	X	–	–	–	–	–	–	–	–	–

Table 8.18, continued

County	Site Name (No.)	References for Geophyte Identification	Estimated Age of Geophyte Occurrences** (Years, B.P.)	Archeological Context and Basis for Age Estimate	Unidentified bulb	Unidentified corm or rhizome	Unidentified root storage part	Unidentified tubers (cf. *Pediomelum* sp.)	Lily family bulb (Lilaceaea, includes wild onion and garlic)	Wild Hyacinth or Eastern Camas bulb (*Camassia scilloides*)	Wild Onion bulb (*Allium canadense* and *Allium* sp.)	False Garlic bulb (*Nothoscordum bivalve*)	Dog's Tooth Violet bulb (*Erythronium* sp.)	Rain Lily bulb (*Cooperia drummondii*)
			2090 ± 50 on Feature 6	Three unidentified bulbs from Feature 6, a large hearths or earth oven (Mehalchick, Killian, Caran, et al. 2000). Radiocarbon date is on Feature 6.	X	–	–	–	–	–	–	–	–	–
Freestone	Bird Point Island (41FT201)	Fritz 1987a	950 to 750	Flotation samples from features yielded unidentified tubers (in 69 samples) and rhizome fragments (in 16 samples); a single charred bulb fragment (1 sample) is probably wild onion (Fritz 1987a:Table 9-1). Most of the tubers are associated with the Round Prairie phase, ca. A.D. 1000 to 1200 (Bruseth and Martin 1987). The tubers are similar to *Pediomelum* sp. (formerly *Psoralea* sp.), which includes "prairie turnip."	–	X	–	X	X	–	–	–	–	–
Grimes	41GM224	Dering 1994; Phil Dering, personal communication 2002	2540 to 1170	Eighteen bulb fragments were recovered from various proveniences (Rogers 1994:154-156). The could not be specifically identified during the original 1992-1994 investigation but were later identified as false garlic (Phil Dering, personal communication 2002).	–	–	–	–	–	–	–	X	–	–

Table 8.18, continued

County	Site Name (No.)	References for Geophyte Identification	Estimated Age of Geophyte Occurrences** (Years, B.P.)	Archeological Context and Basis for Age Estimate	Unidentified bulb	Unidentified corm or rhizome	Unidentified root storage part	Unidentified tubers (cf. *Pediomelum* sp.)	Lily family bulb (Lilaceaea, includes wild onion and garlic)	Wild Hyacinth or Eastern Camas bulb (*Camassia scilloides*)	Wild Onion bulb (*Allium canadense* and *Allium* sp.)	False Garlic bulb (*Nothoscordum bivalve*)	Dog's Tooth Violet bulb (*Erythronium* sp.)	Rain Lily bulb (*Cooperia drummondii*)
Hill	Kyle Rockshelter (41HI1)	Jelks 1962	Late Prehistoric, unspecified	Wild onion bulb fragments (n=65) were recovered from a probable Toyah phase occupation zone, but context is not stated (Jelks 1962:Table 114).	–	–	–	–	–	–	X	–	–	–
Mason	Honey Creek (41MS32)	Dering 1997	290 to 180	Four lily bulbs from a burned rock midden and five lily bulbs from earth oven Feature 7. Four radiocarbon dates were obtained on earth ovens at this site (Black et al. 1997:119, Table 13; Dering 1997:Table 92).	–	–	–	–	X	–	–	–	–	–
McCulloch	Corn Creek 1 (41MK8)	Dering 1997	440 ± 60 on a storage root fragment and 1220 ± 60 from base of burned rock midden	Two unidentified storage root fragments from a burned rock midden. Dates were obtained on a storage root fragment and from midden charcoal (Black et al. 1997:171-182, Table 19; Dering 1997:Table 92).	–	–	X	–	–	–	–	–	–	–
McCulloch	Corn Creek 2 (41MK9)	Dering 1997	870 to 350	Four unidentified storage root fragments from Midden A. Five radiocarbon dates were obtained on wood from the midden (Black et al. 1997:182-201, Table 21; Dering 1997:Table 92).	–	–	X	–	–	–	–	–	–	–
Medina	Jonas Terrace (41ME29)	Dering 1995	3220 to 2330	Eleven bulbs from Stratum 4, a burned rock midden deposit (Dering 1995). Six charcoal radiocarbon dates were obtained from Stratum 4 (Johnson 1995:Table 1).	–	–	–	–	X	–	–	–	–	–

Table 8.18, continued

County	Site Name (No.)	References for Geophyte Identification	Estimated Age of Geophyte Occurrences** (Years, B.P.)	Archeological Context and Basis for Age Estimate	Unidentified bulb	Unidentified corm or rhizome	Unidentified root storage part	Unidentified tubers (cf. *Pediomelum* sp.)	Lily family bulb (Lilaceaea, includes wild onion and garlic)	Wild Hyacinth or Eastern Camas bulb (*Camassia scilloides*)	Wild Onion bulb (*Allium canadense* and *Allium* sp.)	False Garlic bulb (*Nothoscordum bivalve*)	Dog's Tooth Violet bulb (*Erythronium* sp.)	Rain Lily bulb (*Cooperia drummondii*)
Navarro	Adams Ranch (41NV177)	Fritz 1987b	1750 to 950	Feature flotation yielded unidentified tubers (in 23 samples) and rhizomes (in 4 samples) (Fritz 1987b:Table 18-8). Tubers are from all phases of occupation at the site, ca. A.D. 200 to 1000 (Bruseth and Martin 1987). The tubers are similar to *Pediomelum* sp. (formerly *Psoralea* sp.), which includes "prairie turnip."	–	X	–	X						
Travis	Toyah Bluff (41TV441)	Dering 2001	860 to 460	Two complete and 22 onion bulb fragments from feature and nonfeature contexts. Bulbs are associated with earth ovens (Features 2, 11, 9/12, and 12), all of which are thought to date to the transitional period from Austin into Toyah phase, ca. A.D. 1200–1425 (Karbula et al. 2001:148–151).	–	–	–	–	–	–	X	–	–	–
Uvalde	Woodrow Heard (41UV88)	Decker et al. 2000	3500 to 3300	Unidentified lily bulb (probably onion) found adjacent to a burned rock midden. Date is on Midden 3 and is thought to be the approximate age of the surrounding deposits (Decker et al.2000:Table 27, 211-214, 219).	–	–	–	–	X	–	–	–	–	–

Table 8.18, continued

County	Site Name (No.)	References for Geophyte Identification	Estimated Age of Geophyte Occurrences** (Years, B.P.)	Archeological Context and Basis for Age Estimate	Unidentified bulb	Unidentified corm or rhizome	Unidentified root storage part	Unidentified tubers (cf. *Pediomelum* sp.)	Lily family bulb (Lilaceaea, includes wild onion and garlic)	Wild Hyacinth or Eastern Camas bulb (*Camassia scilloides*)	Wild Onion bulb (*Allium canadense* and *Allium* sp.)	False Garlic bulb (*Nothoscordum bivalve*)	Dog's Tooth Violet bulb (*Erythronium* sp.)	Rain Lily bulb (*Cooperia drummondii*)
Val Verde	Baker Cave (41VV213)	Chadderton 1983:Table 7	"Pre-Archaic"	An unspecified number of wild onion bulbs were recovered from the "Pre-Archaic Level" at Baker Cave (Chadderton 1983:Table 7).	–	–	–	–	–	–	X	–	–	–
Val Verde	Eagle Cave (41VV167)	Irving 1966	5000 to 3000	One wild onion bulb was found in Stratum V (Irving 1966:84-85), which is classified as Period II, dating to 7000 to 4000 B.C. (Story 1966:Tables 1 and 2).	–	–	–	–	–	–	X	–	–	–
			Unknown	One wild onion bulb was found in an unspecified context (Irving 1966:84-85).	–	–	–	–	–	–	X	–	–	–
Val Verde	Hinds Cave (41VV456)	Dering 1999a; Dering 2002c	6320 to 5980	Wild onion bulbs were found in an Early Archaic earth oven in Area A. Age is based on two radiocarbon assays (Dering 1999a:661-613).	–	–	–	–	–	–	X	–	–	–
			1250 to 1110	Wild onion bulbs were found in a Late Archaic earth oven in Area F. Age is based on one radiocarbon assay (Dering 1999a:661-613).	–	–	–	–	–	–	X	–	–	–
			Unspecified	Rain lily bulbs found in Hinds Cave (Dering 2002c).	–	–	–	–	–	–	–	–	–	X
Val Verde	Zipilote Cave (41VV216)	Irving 1966	Unknown	One wild onion bulb was recovered from undifferentiated deposits.	–	–	–	–	–	–	X	–	–	–

Table 8.18, continued

County	Site Name (No.)	References for Geophyte Identification	Estimated Age of Geophyte Occurrences** (Years, B.P.)	Archeological Context and Basis for Age Estimate	Unidentified bulb	Unidentified corm or rhizome	Unidentified root storage part	Unidentified tubers (cf. *Pediomelum* sp.)	Lily family bulb (Lilaceaea, includes wild onion and garlic)	Wild Hyacinth or Eastern Camas bulb (*Camassia scilloides*)	Wild Onion bulb (*Allium canadense* and *Allium* sp.)	False Garlic bulb (*Nothoscordum bivalve*)	Dog's Tooth Violet bulb (*Erythronium* sp.)	Rain Lily bulb (*Cooperia drummondii*)
Williamson	Wilson-Leonard (41WM235)	Dering 1998b	7997 ± 21	Average age of nine radiocarbon dates on separate camas bulbs from Feature 181, a "large burned rock basin" (Guy 1998:1150-1153; Stafford 1998:Table 25-3).	–	–	–	–	–	X	–	–	–	–
			8250 ± 80	One radiocarbon date was obtained on a camas bulb from Feature 8, a "burned rock accumulation" (Guy 1998:1111-1112; Stafford 1998:Table 25-3).	–	–	–	–	–	X	–	–	–	–
			3780 ± 70	One camas bulb from burned rock Midden 2 is radiocarbon dated to the Late Archaic (Guy 1998:1, 204; Stafford 1998:Table 25-3).	–	–	–	–	–	X	–	–	–	–
Williamson	Block House Creek (41WM632)	Dering 1999b	1790 to 900	Five onion bulb fragments were recovered from Midden 3 (Bowden 1999:67-68, Table 5.1, Appendix B).	–	–	–	–	–	–	X	–	–	–
			1242 to 530	Two onion bulb fragments were recovered from Midden 4 (Bowden 1999:67-68, Table 5.1, Appendix B).	–	–	–	–	–	–	X	–	–	–
Williamson	Rice's Crossing (41WM815)	Dering 2003b	2770 to 2140	Twenty-eight camas bulb fragments from Feature 9, a large stone-lined pit interpreted as an earth oven. Age span is based on 16 radiocarbon dates from in and around Feature 9 and is ca. 820–190 B.C. (Brownlow 2000; 2003).	–	–	–	–	–	X	–	–	–	–

Table 8.18, continued

County	Site Name (No.)	References for Geophyte Identification	Estimated Age of Geophyte Occurrences** (Years, B.P.)	Archeological Context and Basis for Age Estimate	Unidentified bulb	Unidentified corm or rhizome	Unidentified root storage part	Unidentified tubers (cf. *Pediomelum* sp.)	Lily family bulb (Lilaceaea, includes wild onion and garlic)	Wild Hyacinth or Eastern Camas bulb (*Camassia scilloides*)	Wild Onion bulb (*Allium canadense* and *Allium* sp.)	False Garlic bulb (*Nothoscordum bivalve*)	Dog's Tooth Violet bulb (*Erythronium* sp.)	Rain Lily bulb (*Cooperia drummondii*)
Williamson	41WM1010	Phil Dering, personal communication 2003	1230 to 990	Recent work by PBS&J, Inc.; not yet published (Phil Dering, personal communication 2003). Feature D56, a probable earth oven, yielded 9 unidentified bulb fragments. The feature is Late Archaic in age and is radiocarbon dated to A.D. 720–960.	X	–	–	–	–	–	–	–	–	–
Number of sites where geophytes have been found (33 sites in 16 counties)					5	4	2	2	4	11	15	1	1	1

* Most finds are associated with burned rock features. This table excludes findings of unburned bulbs in coprolites from dry shelters in Val Verde County and west Texas (for example, see Williams-Dean 1978).

** The estimated age is based on either (a) actual radiocarbon dates (corrected radiocarbon ages) on charred bulb remains or (b) associations between bulbs and dated features or cultural zones (total age span of one or more applicable radiocarbon dates).

the two largest trees that survived the brush clearing are both post oaks.

The palatability of acorns is directly proportional to the amount of tannins present, and varieties of white oak are much lower in tannin than are the black oaks (Martin et al. 1961:308). Although it is possible that people cooked some oak acorns in earth ovens, especially those high in tannins, it is more likely that leaching in water or stone boiling were the preferred methods of removing tannins. Stone boiling could have been used to cook all types of foods but was particularly important for processing some kinds of oak acorns (Creel 1986:124–132; 1991:42).

Almost anything can be cooked in an earth oven, but ethnographic evidence suggests that neither oak acorns nor pecan nuts were commonly processed in pit features (Dering 1998, 1999; Ellis 1997). No thorough literature search was attempted, but charred acorns have been found in many other central Texas sites as the examples below attest. Dering (2001b) notes the presence of charred acorns in a rock-filled pit from a site in Bandera County (41BN100), about 175 km southwest of Fort Hood. Schroeder and Oksanen (2002:48,268–269) report that oak acorns were recovered from a burned rock cluster (Feature 8) dating to about 8600 B.P. at the Armstrong site in Caldwell County. Oak acorns were found at 7 out of the 10 prehistoric sites investigated at the San Gabriel and Granger Reservoirs in Williamson County (Crane 1982). Charred acorn fragments also were recovered from two sites on Fort Hood. One was found at the Clear Creek Golf Course site, 41CV413 (Dering 2002a; Mehalchick et al. 2002:35), and unusually high numbers of charred acorns were recovered from a burned rock mound at 41CV686-A (Dering 2001b; Mehalchick et al. 2001).

Exactly how oak acorns were processed in central Texas is not known, nor is it certain what role earth ovens and middens played in acorn processing. One school of thought is that earth ovens and burned rock middens are functionally related to processing acorns. Creel (1986:123–155) suggests that burned rock middens are largely accumulations of fire-cracked limestone that was used for boiling stones to leach the tannin from acorns. He thinks that the acorns were then ground into meal and made into bread and that the large hearths or earth ovens found within middens were used to bake acorn bread (Creel 1986:153). Both Creel (1986:126) and Ellis (1997:Table 3) cite many ethnographic accounts showing that acorns were ground into meal and made into bread that was then baked in earth ovens. In yet another example, whole acorns were cooked in an oven. Barrett (1952:76) notes that "acorns were buried whole in mud, then excavated when moldy and baked in the shells (pericarp) in an underground oven" (as cited in Black et al. 1997:587).

The opposite school of thought is that the earth ovens and middens were not used to process acorns or cook acorn bread and that the occurrence of charred acorns is purely incidental. Many ethnographic accounts (see Creel 1986:124–125) suggest a simple process in which acorns were soaked in water. One possibility is that as acorns were harvested and cracked open for grinding, large quantities of acorn shells were generated as a byproduct. This material, which would have been wasted otherwise, was then used as fuel. In such cases, the charred acorn fragments could appear in open hearths, earth ovens, and midden deposits, but these features had nothing to do with acorn processing or cooking. Ellis (1997:Table 3) cites several ethnographic accounts of whole acorns being roasted directly in open fires and smoked or dried over open fires. In this scenario, it would be possible for acorns to be accidentally burned and discarded into the hearth.

From these examples, it seems that several different scenarios could explain how oak acorn pericarp fragments got into the pit features at the Firebreak site. It is possible that acorns were accidentally burned while they were being cooked whole in an earth oven, but this seems unlikely because there are so few ethnographic accounts for this type of acorn processing. If acorns were parched or dried over an open fire or on a griddle rock, some could have been accidentally dropped into the fire and burned. In this case, the rock-lined pits would not have functioned as earth ovens at that particular moment, but they certainly could have served as open hearths for a time and then been converted into earth ovens after the fire died down. The third and most plausible explanation is that acorns were processed on site but that the shell fragments (pericarp) and cup-like woody bases (involucre) were simply used as fuel. In this scenario, acorns would have been gathered in large quantities, hulled, leached, and ground into meal by the people living at the Firebreak site. The waste piles of acorn shells were then thrown into earth ovens as kindling or fuel. This latter explanation fits better with most ethnographic accounts of acorn processing. It also is supported by the fact that charred oak acorns found in central Texas archeological sites are usually only pericarp fragments rather than whole acorns (Phil Dering, personal communication 2003).

If acorns were being gathered, processed, and turned into bread by the people at Firebreak, then it is possible that the acorn bread was baked in the earth ovens. There is no definitive evidence for this, however, and the fact that acorns were harvested and processed on site does not presume that any particular cooking technique was used to prepare acorn bread or that bread was made at all. Acorn meal could have been used in many other ways, such as dried and mixed with other foods or made into thin cakes and cooked directly on griddle stones over open fires (see Ellis 1997).

For pecans, Ellis (1997:Table 3) cites only one example of whole nuts being baked in a pit, and Brown (1995:6) notes that "mild heating of pecan meat (to about 176° F) [or 80°C] promotes storage by inactivating oxidative enzymes." But it was most common historically for pecans to be consumed with little or no special preparation or cooking, and even pecans found on the ground many months after they fall from the tree are often edible if other animals haven't gotten to them first. Hall (2000:107–108) notes that pecans are easy to store, both above or below ground, and are edible without doing any special processing. They also may be shelled and mixed with other foods before they are consumed, or added to other foods for flavoring before being cooked.

We can never know for sure, but it is reasonable to suggest that the pecan shell fragments at the Firebreak site were simply being thrown into pits as fuel along with various woods. If this is the case, the pecans would not be associated with earth ovens. The most likely scenario is that pecan nuts were gathered in large quantities, brought to the site and shelled, and that the discard piles of pecan shell fragments (i.e., pericarp) were a convenient source of fuel (see Brown 1995:6). In any case, the finds clearly indicate that people at Firebreak were using pecans.

Archeological Remains and Plant Processing

Most of the burned rock features at the Firebreak site are thought to be related to plant processing. Features 11 and 15 resemble each other greatly in morphology and appear to represent contemporaneous oven pits. They certainly were used in the same general time frame and may actually have been in use at the same time, possibly indicating that there were different oven pits for cooking different foods. If this is the case, it would represent very specialized kinds of food processing. The abundance of oak wood (64 g or 68.7 percent) within the charred wood assemblage is evidence of the ready availability of oak acorns during prehistoric times. There is charred oak wood present in every feature and nonfeature context that yielded macrobotanical remains (see Appendix C).

Besides the earth ovens, there are various other hearths and burned rock concentrations or clusters. One large hearth (Feature 12) may have been used as an open-air cooking facility based solely on its construction (i.e., a single layer of flat rocks). The precise function of a small, circular, basin-shaped hearth (Feature 14) is unknown, but it could be an open-air hearth or a small pit oven. Although the burned rock concentrations and clusters (Features 5, 9, 10, and 13) are isolated and discrete, their functions are uncertain. It is unclear if they are associated with stone boiling, represent debris from cleanout of a nearby hearth or oven pit, or are simply features disturbed by human or natural forces.

Compared with the other burned rock features at Firebreak, Features 5 and 9 are unusual. They are small single layers of fist-sized stream cobbles that are clustered but not tightly spaced. The random nature of the rocks suggests a dump (or dumps). Features 5 and 9 are most likely dumps of boiling stones.

A quick comparison of the sizes of burned rocks that compose the Firebreak features reveals significant differences that support the functional interpretations above (Table 8.19). Dump Features 5 and 9 differ in that only one size of rock (i.e., the 5–15 cm class) is represented and nearly all are rounded or tabular stream cobbles that were almost certainly obtained from channel gravels in nearby Stampede Creek. All are discolored (reddened) from heating, but most

Table 8.19. Comparison of burned rock size distributions for selected features, 41CV595

Feature Type	Feature No.	Test Units	Sample Size (estimated % of feature)	Inferred Function	Sample Rock Weight (kg)	Estimated Total Rock Weight (kg)	Percent by size class (calculated by weight) <5 cm	5–15 cm	15–25 cm	25–35 cm	35–45 cm
Burned rock mound	3	57, 63	5	discard from earth oven cooking	375.0	7,500.0	10.93	75.60	13.47	0.00	0.00
Earth ovens	4	63, 64, 65	95	subsurface pit used for cooking plant foods	306.5	322.6	1.14	18.92	62.81	14.68	2.45
	8	27, 28, 33	60	subsurface pit used for cooking plant foods	292.3	487.2	1.92	69.14	24.39	4.55	0.00
	11	31, 34, 35, 36	100	subsurface pit used for cooking plant foods	275.8	275.8	22.12	44.24	23.21	10.43	0.00
	15	42, 43, 49, 50	85	subsurface pit used for cooking plant foods	222.3	261.5	6.88	29.91	33.29	16.87	13.05
Burned rock dumps	5, 9	62, 66	45	unknown; possible stone boiling dump	15.5	34.4	0.00	0.00	100.00	0.00	0.00
	10	32	100	unknown; possible stone boiling dump	3.0	3.0	0.00	0.00	100.00	0.00	0.00
	13	13	100	unknown; possible stone boiling dump	13.5	13.5	22.22	77.78	0.00	0.00	0.00
Hearth (flat)	12	29	100	unknown	23.5	23.5	2.13	97.87	0.00	0.00	0.00
Hearth (basin-shaped)	14	52	100	unknown	3.5	3.5	42.86	57.14	0.00	0.00	0.00

Note: Shaded cells represent more than 15 percent of all burned rocks in each feature.

(more than 80 percent) of these cobbles are whole. It is common knowledge that different limestones behave differently when heated, but it is generally true that all limestone rocks will eventually break down into angular pieces if heated intensively enough or often enough. Based on the experimental heating of stream cobbles from Stampede Creek (see discussion of Area 3 features in Chapter 8), it appears that the rocks of Features 5 and 9 were probably heated only once or twice. It also is likely that these cobbles were intentionally selected for their size and shape, which are important characteristics for stone boiling.

It is far from certain, but if Features 5 and 9 do represent one or more dumps from stone boiling, then it is possible that the stone boiling episodes were related to acorn processing (Creel 1991:42). Creel (1986:125–126) cites several ethnographic examples demonstrating at least three types of stone boiling done in conjunction with acorn processing. One method was to pour the hot water over ground acorn meal to leach out the tannins. Another was to add lye (derived from ashes) to the water and boil whole acorns to leach out the tannins. Yet another technique was to obtain vegetable oil by boiling acorns and skimming the oil from the surface of the water.

Although 75 percent of the burned rocks making up the Feature 3 mound are in the 5–15 cm size class, most of these specimens (at least 80 percent) have one or more angular fractured edges and appear to be broken pieces of much larger slabs. Also, a sizable portion (11 percent) of the mound is made up of small rocks less than 5 cm in size.

The earth oven features differ in that more than 75 percent of the rocks in each feature are in the 5–15- and 15–25-cm size classes, but perhaps more important, a fair number of rocks in each feature are quite large (between 4.5 and 16.9 percent of the rocks in each earth oven are larger than 25 cm). It also is clear that many of these larger burned rocks were complete tabular slabs because they were found fractured in place or were whole but broke apart when they were removed. There seems to be little doubt that most of the large rocks lining the earth ovens were heated in situ (at least the last heating episode). In contrast, virtually all of the burned rocks in the mound represent smaller fire-fractured slab pieces that had been heated elsewhere. It is assumed that most of the mound rocks were heated in the central earth oven but were later discarded into the mound deposit each time the earth ovens were cleaned to remove the smaller broken rocks.

Like the abundant burned rock features, the artifacts from the Firebreak site also tell a story of plant processing. The tool kit includes pitted or nutting stones and metates (see Figures 7.21 and 7.22), two types of implements that are associated with preparing wild plant foods. Certainly these tools could have been used to grind meat or nonfood items, but they are most commonly associated with processing a variety of nuts, berries, and seeds and other plant remains. Acorns and pecans were probably ground into meal at Firebreak.

Mary Malainey's analysis of organic residues preserved on a selected sample of burned rocks (n = 12) and in the grinding basin of the complete metate provides interesting observations on plant use at the Firebreak site (see Appendix C). Although the interpretations are by no means definitive, the classes of fatty acids that were found on the archeological samples do support some of the interpretations of feature and tool functions. This study yielded important conclusions:

- There appear to be no residues from the meat of large herbivores (such as bison and deer) in any of the 12 samples. This evaluation is consistent with interpretations that the earth ovens and burned rocks that dominate the site are related to plant processing.
- Burned rocks from two earth ovens, Feature 8 (Samples 5 and 6) and Feature 11 (Samples 7, 8, and 9), contained residues reflecting moderate-high to very-high fat-content foods, possibly mammal fat or high-fat-content seeds or nuts (e.g., pecans or acorns). These interpretations are consistent with the archeological evidence because oak acorns and pecan shells were found in these features (see Appendix B). Also, the only bones found at the Firebreak site were from the fill of Features 8 and 11, perhaps indicating that some animal remains were cooked as well.
- Burned rocks from Features 8, 10, and 15 (Samples 4, 3, and 11 and 12) yielded residues typical of moderate to high fat content foods, and one rock from the

Feature 15 earth oven probably contained plant residue.

- Two burned rocks (Samples 1 and 10) yielded residues from medium-fat to moderate-high-fat-content foods, and a third burned rock (Sample 2) produced residue from medium-fat foods. That these residues differ from the others is intriguing because two of these rocks (Samples 1 and 2) are from Feature 5, a cluster of rocks that could represent a dump of boiling stones, and it is possible that these were used to boil oak acorns. The third rock (Sample 10) is from the Feature 15 earth oven.
- One interpretation of the fatty acid composition of the residue extracted from the grinding basin of the complete metate (Sample 13) is that it represents a combination of a moderate-high-fat food and a low-fat plant food. It is possible that low-fat plants such as the wild onion and camas bulbs were ground on this metate after they were cooked in the earth ovens.

SEASONAL USE AND SITE FUNCTION

Determining seasonal use of hunter-gatherer sites is an important research avenue but is often frustrating because the data are so limited and subject to various interpretations. Looking at the availability of particular plant and animal resources as the principal evidence for seasonal use, there are only four taxa that contribute to this study. All four represent edible plants found in association with earth oven features at Firebreak, but they represent different harvesting seasons (see Table 8.17).

Although geophyte bulbs were available year-round, these plants were probably harvested by people only when their above-ground portions were growing and flowering so they were easy to recognize. For geophytes in the lily family, Thoms (1989:68) notes that, "Because people are not effective at detecting the presence of underground storage organs with their olfactory senses, we might expect them to dig for roots when the above ground parts are visible, namely during the late spring and early summer. The relative size of the leaves, stems, and flowers is indicative of bulb size, and people probably recognized this correlation and acted accordingly." He also notes that the spring and early summer "is the time when the bulbs retain the greatest proportion of the nutrients stored during the previous growing season." For eastern camas in central Texas, late spring to early summer is the most likely harvest because the above-ground portion of the plant disappears by midsummer. "The bulbs are almost impossible to relocate when the plants are dormant" (Cheatham and Johnston 2000:519). The camas flower stalks appear in March–April and may last into the summer.

Wild onions also flower at the same time, but they may be found throughout the summer and fall. Wandsneider (1997:23) notes that camas was "exploited just after flowering" because the bulbs were at their peak in terms of nutrition. She states "the time during which the maximum amount of energy could be harvested from the plant is just before that energy is directed to reproduction."

Ethnographic evidence indicates that both wild onions and camas could be stored, either cooked or uncooked, if they were properly dried. Storage could be above ground (e.g., in baskets) or in subterranean pits (e.g., Cheatham and Johnson 1999:220; 2000:522–523; Thoms 1989:228–234). Wandsneider (1997:24) notes that many pit-baked foods were further processed for storage or to increase their longevity:

> …Detailed accounts of agave, camas, and sotol processing speak of baking the product for several days, removing it from the pit, and kneading the hydrolyzed product into cakes or loaves. These were either sun-dried or further baked to reduce water content (and its availability to microorganisms) and, therefore, the possibility of spoilage. The final product, whether camas or agave, had the consistency of plug tobacco, was easy to transport, and preserved well if kept dry.

Oak acorns and pecan nuts are available for harvest at about the same time in central Texas. Both fruits ripen and fall from the tree from September to November (Vines 1996:127, 147–202), when harvest is as easy as gathering them off the ground. Oak and pecan trees tend to cluster in large groves, and sizeable amounts of both foods can be obtained with relatively little labor. Although Brown (1995:6) cautions that pecan shells may be picked off the ground and used as fuel in hearths during almost any season, the fact that both acorns and pecans are present at Firebreak strongly suggests fall occupations and exploitation of these resources.

In conclusion, direct evidence for seasonal use consists of four plant species that would likely have been harvested and processed during the spring–summer and the fall. Some charred wood taxa—such as dogwood, hackberry, mulberry, persimmon, and walnut—also provide indirect evidence that other nuts and berries were available during the same times of the year. This suggests bi-seasonal use of the Firebreak site. It is likely that people occupied the site at two different times of the year—spring-summer and again in the fall—rather than continuously.

As for site function, it seems plausible that occupations at the Firebreak site were not only highly seasonal but also brief and specialized. People were drawn to the site in the spring-early summer to harvest the bulbs of wild onions and eastern camas that were in bloom. They returned to the Paluxy sites in the fall to gather the oak acorns and pecan nuts. Only four targeted resources have been identified, but there were likely many more important plants harvested at these same times. The Firebreak area was a good camping place because it had sandy soils that were well drained and easy to dig, an abundance of limestone rocks and wood immediately available for cooking, and a wide range of target resources situated within a few kilometers of the site. All lines of evidence suggest that although people lived at Firebreak, they were focusing on harvesting and processing plant resources that were available in large quantities for short periods. Wandsneider (1997:23–24) notes that "the window of maximum opportunity for harvesting camas or agave or other similar plants at any one locale, thus, was likely on the order of several weeks. Mass processing, then, may be a response to the narrow small window of availability and the short amount of time allowable between harvesting and spoilage."

PALEOENVIRONMENTAL RESEARCH

The geoarcheological data (e.g., geomorphic evidence, faunal remains, macrobotanical remains) from the Firebreak site are not particularly useful for paleoenvironmental interpretations because the sandy deposits represent a long span of time but lack any natural or cultural stratification. The faunal evidence is too limited to interpret, and the wide array of trees represented in the macrobotanical assemblage comprises species that still grow in the area today.

The presence of these trees perhaps suggests that environmental conditions over the last 3,000 years were generally similar to modern conditions, but even this interpretation is tenuous. Many types of data that are useful for paleonenvironmental interpretations in other settings, particularly stratified alluvial deposits, should not be applied at Firebreak or any other Paluxy site. The contextual problems related to the deposition and postdepositional disturbances of the homogenous sandy sediments limit the utility of many types of analyses.

Carbon isotopes derived from the sediments are useful for gross paleoenvironmental reconstructions and have been used at Fort Hood. Nordt (1993:62–70, Figure 4) used carbon isotopes from buried soils in alluvial deposits to reconstruct past vegetation regimes in the Fort Hood area. Using carbon isotope data from a buried A horizon at one Paluxy site, Kibler (1999:57) speculated that "Paluxy site mantels were dotted with trees, rather than grasslands like most upland localities." This interpretation agrees with the modern observation that post oak and blackjack oak trees are abundant in Paluxy sands but do not seem to grow on the surrounding slopes or uplands (Kleinbach et al. 1999:389). Although there are buried soils at the Firebreak site (see Chapter 7), no areas were identified as good candidates for carbon isotope analysis and paleonvironmental interpretation. Because of the high degree of cultural enrichment of the buried A horizons on the site, the resulting isotope data would not be representative of the natural environment.

Although the Firebreak site data do not contribute to our understanding of regional paleoenvironmental reconstructions, the regional data do aid our understanding of prehistoric life at the Firebreak site. As shown in Figure 8.14, six paleoenvironmental reconstructions for central Texas are based on different data but show some continuity. In these different reconstructions, the overall patterns of

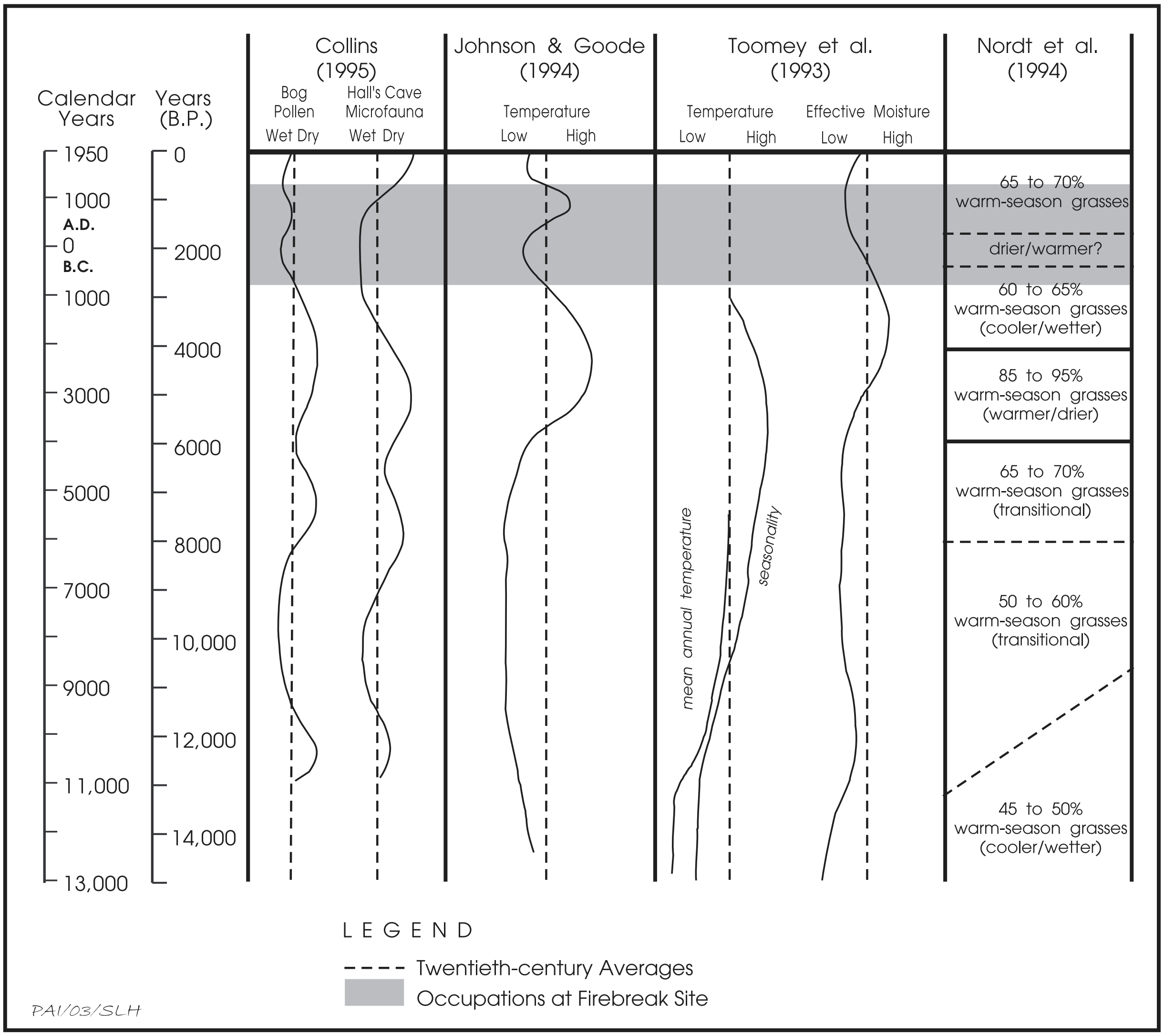

Figure 8.14. Firebreak site occupation period compared with regional late Holocene paleoenvironmental reconstructions.

middle to late Holocene climatic shifts are generally similar, but the precise timing of when the changes occurred differs. Six different data sets used in this comparison are:

- Bog Pollen from Weakly and Boriak bogs, Collins 1995; Collins et al. 1993, East-central Texas
- Microfauna from Hall's Cave, Collins 1995 Edwards Plateau
- Alluvial sequence and other regional data, Johnson and Goode 1994, various localities in central Texas
- Temperature data from Hall's Cave, Toomey et al. 1993, Edwards Plateau
- Effective moisture data from Hall's Cave, Toomey et al. 1993, Edwards Plateau
- Carbon isotope date from alluvial deposits, Nordt et al. 1994, Fort Hood

Compared with our modern climate, much of the period between 4000 and 1000 B.C.—which encompasses the Middle Archaic cultural period—is characterized as significantly hotter and dryer. By the time people first came to live at the Firebreak site sometime around 1000 B.C., conditions had become wetter and cooler, perhaps approximating the modern climate. The data of Collins (1995) and Johnson and Goode (1994) show this trend continued until sometime between A.D. 1 and 500 (or later?).

In contrast, the data sets of Toomey et al.

(1993) and Nordt et al. (1994) suggest a drying trend from 1000 B.C. to until A.D. 1 or later. By around A.D. 1000 to 1200, when the occupations ended at Firebreak, people were experiencing a climate that approximated modern conditions. Although the paleoclimatic reconstructions do not agree entirely, one important point is worth noting. Conditions throughout the 2,000-year period of occupations at the Firebreak site may have been a little wetter or dryer than normal, but they were never as severe as the extremely arid conditions during the Middle Archaic period.

SUMMARY OF SITE-SPECIFIC RESEARCH QUESTIONS

Throughout this chapter, archeological data have been interpreted to present a picture of human activities at the Firebreak site during the Late Archaic and Late Prehistoric periods. This final section briefly summarizes these interpretations by addressing each of the research questions posed in Chapter 3.

Chronology

When did site occupation begin and end?

Radiocarbon dates indicate the occupations at the Firebreak site span from 790 B.C. to A.D. 1263. Temporally diagnostic artifacts correspond with this age assessment.

How many components (i.e., discrete periods of occupation) can be defined?

Excavations in three separate areas revealed horizontal separation of activities, and each of the three assemblages of artifacts and features was examined separately. Within each area, however, it was not possible to separate features or artifacts vertically into meaningful units (or cultural components). The assemblages from all three areas were then combined and examined as a single unit. Although this combined assemblage represents a long expanse of time—possibly as much as 2,000 years—it provides evidence for continuity of cultural activities during multiple occupation episodes.

Are the radiocarbon dates, temporally diagnostic artifacts, and stratigraphic integrity sufficient to help reconstruct a relative chronology for the site?

The short answer is unequivocally no. The radiocarbon evidence, derived primarily from feature-associated carbon samples, does show that the three excavation areas contain occupation residue from different time periods. Unfortunately, neither the temporally diagnostic artifacts nor the radiocarbon dates are precise temporal data. All three areas could have been used contemporaneously throughout the period of site occupation (see Figure 8.1), but people may have alternately occupied the different areas, or none of the areas were used at the same time.

The temporal resolutions of radiocarbon dates and archeologically defined ages of point styles are simply too gross to reconstruct any relative chronology of occupations at Firebreak. It is clear that all three areas within the site experienced repeated occupation episodes, but we do not know precisely when they occurred.

Are there sufficient contextual links between absolute dates and temporally diagnostic artifacts to contribute to the regional chronology reconstructions?

The answer, again, is no. Although some diagnostic projectile points were found in association with some features, these associations pertain to location only. None of the diagnostic artifacts can be said to be functionally, or even temporally, associated with the use of any particular feature. Hence, we cannot assume that any particular dated feature and the artisfacts found in the fill associated with that feature or in the sediment nearby are linked. Although the regional chronology helps us understand the occupations at the Firebreak site, the evidence from the Firebreak site does not contribute significantly to or help refine the temporal resolution of the central Texas regional chronology.

Site Formation

To what extent does the spatial patterning (both vertical and horizontal) of artifacts reflect cultural or natural processes (e.g., colluvial slopewash)?

In some geomorphic settings, particularly where fine-grained alluvium accumulated very rapidly, the locations of artifacts and conditions of features observed archeologically accurately reflect the cultural activities that generated them. In other, more dynamic settings, objects get moved around after they are initially deposited, and their archeological locations reflect postdepositional processes rather than cultural activities, which is true of the Firebreak site. Although some features and portions of features were found to be intact at Firebreak, it is argued that the depositional environment there was not conducive to preserving precise archeological contexts.

The geoarcheological evidence indicates that the site occurs on a moderate slope that was continually subject to and disturbed by erosion, downslope transport of sediments, and redeposition; the cultural remains are contained within a loosely consolidated sandy matrix that is extensively bioturbated; and the deposits accumulated very slowly across most of the site. As a result, the erosional and biological processes have taken their toll in terms of the spatial relationships between cultural objects, particularly the many small stone artifacts that comprise most of the assemblage.

The horizontal and vertical distributions of the Firebreak artifacts are a result of complex interactions between cultural and natural processes, and it must be concluded that the effects of natural processes have been significant but are difficult to quantify nonetheless.

What does the geomorphic, chronological, and archeological evidence reveal about site formation and the number and intensity of occupations?

The case for multiple occupations over a long period is strong. Unfortunately, there is no way to know how many occupations occurred or how intensive any particular occupation was. The evidence suggests that the nature of the occupations at Firebreak changed little through time and that most of the occupation episodes had rather specialized site functions. If our interpretations of specialized plant processing activities are correct (see Site Function and Seasonal Occupation below), it seems reasonable to interpret the archeological evidence as reflecting short periods of intense activities.

How do the site formation processes represented at one site fit with what is known about such processes at other Paluxy sites?

The investigations at the Firebreak site confirm the previous interpretation of site formation in the Paluxy environment as Kibler described it (1999). There were no particularly surprising geomorphic interpretations. The Firebreak work does suggest that the typical culture-bearing deposits at most Paluxy sites, which are generally little more than a meter thick, will often represent a considerable span of time. There also is not likely to be any natural or cultural stratification within such deposits because they represent a slow accumulation of homogenous sandy sediments that were subject to many postdepositional disturbances.

There is, however, a greater potential for stratification, or at least some degree of meaningful vertical separation, of cultural materials in gully fill deposits that are 2 to 3 m deep. In other words, it it possible that deep gullies filled rapidly and discrete occupation materials from different time periods are vertically separated in some sites, but this remains to be demonstrated. Furthermore, it is impossible to predict where deep gullies will occur on any given Paluxy site based on surface evidence. The discovery of deep gullies in test Paluxy sites has been fortuitous, and there seem to be no meaningful pattern to their occurance.

Lithic Procurement and Reduction Strategies

What types and sources of stone were used to make chipped stone tools?

Most of the chert materials represented in the tools and debitage from the Firebreak site could not be identified to named types, but 24 percent of the assemblage was assigned to 11 types representing primary outcrop sources and 6 types of Cowhouse alluvial gravels (see Table 8.11). Most of these materials were almost certainly obtained locally (within 5 km of the site) or nearby (within from 5 to 15 km of the site).

Of the artifacts made of unidentified chert types, many of the specimens are of light-colored materials that were, in all likelihood, obtained locally or nearby as well.

Thus, it appears that the inhabitants of the Firebreak site relied primarily on materials found close to the site. Given the overall limited nature of the lithic reduction activities, it is likely that people at Firebreak did not make specific trips solely to acquire raw lithic materials but obtained the cherts during other foraging trips in the vicinity.

What types and sources of stone were used to make ground stone tools?

The ground stone tools recovered from Firebreak—two metates and two nutting stones—are all made of native limestone that is available within a kilometer of the site. The only battered stone that was recovered is a hammerstone made of chert.

What do the finished tools and debitage reveal about manufacturing techniques for stone tools?

The stone tool assemblage (see Table 8.16) and the high percentage of small pieces of noncortical debitage (see Table 8.12) indicate that much of the stone working activity was late-stage reduction aimed at biface production. Most of the chert materials brought to the site were not raw cobbles but were already reduced to more transportable forms, probably early-stage bifaces.

What do the broken or reused tools reveal about artifact use?

Twenty-nine of the 30 broken bifaces from the site probably represent manufacturing failures, and the high frequency of reworked points (all 12 of the complete and nearly complete specimens) assemblage suggests that tool reuse was common. The high frequency of proximal point fragments (36 percent of the points) is probably related to retooling hunting weapons and discarding the unusable stem fragments.

Subsistence Technologies and Resources

What tools and techniques were used to exploit different plant and animal resources?

Although hunting activities may have occurred, they were of relatively minor importance compared with plant processing. The Firebreak site is dominated by burned limestone mounds and middens with earth ovens that denote cooking of bulk plant foods. Limited stone boiling may have occurred–and perhaps was related to processing oak acorns–but the principal subsistence activities involved earth oven cooking. In all likelihood, the earth ovens were used to cook large quantities of inulin-rich root foods (i.e., geophytes) that were made palatable through hydrolytic conversion of complex carbohydrates into simple sugars.

What is the direct (such as faunal and botanical remains and organic residues) and indirect evidence (such as functional inferences for stone tools) for exploitation of specific animals and plants?

Direct evidence for intensive processing of wild plant foods includes finds of charred remains of four plants—bulbs of wild onions and eastern camas (or wild hyacinth) and fragments of pecan nutshells and oak acorn pericarps. Although not as specific, fatty acid plant residues found on burned rocks and grinding stones also constitute direct evidence The indirect evidence is the strong functional association between the burned rock features and the charred plant remains.

Wild onions and camas are both geophytes that could have been efficiently harvested in close proximity to the site and processed in bulk quantities using earth oven technology. Direct evidence for exploitation of animals is limited to a handful of unidentified bones and a few mussel shells, and indirect evidence is even more limited. As cautionary notes, there may be many other plant resources that were exploited at Firebreak, but they left little archeological evidence behind, and the impression that hunting activities were limited may be greatly enhanced by poor preservation.

What features were used (or probably used) in cooking and producing food?

Large rock-lined pits at the Firebreak site are interpreted as earth ovens used for slow cooking large quantities of food. These pits were most likely used for processing various root foods (i.e., geophytes) that require extended cooking times to render them palatable. Reuse of these pit features over time resulted in large accumulations of scattered burned rocks focused around a central pit.

How were heating and cooking features constructed?

Archeological evidence indicates that the earth ovens were constructed by digging a shallow bowl-shaped pit about 1.5 to 2 m in diameter and lining its edges with large slabs of locally available limestone. It also is clear that wood and other combustible materials were burned in the pits. Beyond this, the evidence indicating that these pits functioned as earth ovens—with insulation, foodstuffs, and an earthen cap added to seal in the heat retained in the limestone rocks—is circumstantial but strong nonetheless.

What was the source of stone for use in heating and cooking features?

All of the burned rocks at Firebreak, whether scattered or in features, are limestone. All of these rocks would have been available within 50 m of the site. As observed at many other Paluxy sites, most of the burned rocks at Firebreak are fossiliferous. Fossiliferous Walnut Clay limestones are found just upslope from the site, and this is the most likely source, although fossiliferous limestones are found in parts of the Glen Rose and other Cretaceous formations on Fort Hood.

What fuel sources were used in heating and cooking features?

A wide variety of charred woods was recovered from cultural features at the Firebreak site. Species that were used as fuel are ash, black locust, boxelder, dogwood, elm, hackberry, maple, mulberry, oak, persimmon, rose family, sumac, walnut, and willow. It also was suggested that the charred fragments of pecan shells and oak acorn pericarp found in the earth oven pits were burned as fuel rather than being accidentally burned while whole pecans and acorns were cooked in the pits. The various trees used as fuel represent a combination of upland and riparian species that occur both upslope and downslope from Paluxy outcrops.

Site Function and Seasonal Occupation

Do the features, artifacts, and other evidence indicate why the site was occupied and what various types of activities occurred there?

Most of the individual occupations at the Firebreak site are thought to have been functionally specialized, emphasizing harvesting and mass processing of selected plant resources. Many important plant foods—such as onions, camas, and oak acorns—could be found on and around the Paluxy soils, and Firebreak would have been a convenient camping location while exploiting these resources. Harvesting and processing these resources would have required extensive labor and intensive activities for short periods.

How intensively was the site used over time? And, if use intensity fluctuated over time, what factors may account for this?

It is impossible to determine how many occupations there were or how intensive they were, but it is reasonable to speculate that the Firebreak site was the scene of many short-duration occupations over a long period.

What is the evidence of seasonal occupations?

The best evidence of seasonal prehistoric occupations is the presence of charred remains of four plants—wild onions, camas, pecans, and oak acorns—that were likely important food resources for the inhabitants. Although onion and camas bulbs could have been dug up at almost any time of the year, they are nearly impossible to find except during the flowering period. Botanical and ethnographic evidence indicates that the spring or early summer was when these plants flowered and bulbs would have been harvested and processed. In the same way, pecans and acorns could have been picked off the ground throughout the year, but they were probably harvested in the fall when they first dropped from the trees and before they were gathered by other animals, eaten by insects, or began to spoil. Thus, it seems likely that the Firebreak site was inhabited during two different seasons.

What do the artifacts and features reveal about overall resource procurement strategies? And, do occupations at the site reflect forager or collector subsistence strategies?

As Chapter 9 discusses in more detail, it is speculated that the people occupying the Firebreak site were foragers who lived there for short periods during the spring–early summer and the fall to take advantage of the abundant plant foods that could be harvested at those times. It is unlikely that any individual occupation episode lasted more than a few weeks, during which time the inhabitants would harvest all of the plants that became available around the site and return them to camp for bulk processing.

The availability of firewood near the site would have been important, especially during the spring when large quantities of geophyte bulbs were cooked. It is possible that there were many times when the site would have been abandoned completely for a few years because either the plant foods or firewood were depleted.

Paleoenvironmental Research

Can any of the geomorphic evidence or faunal and botanical assemblages from the site be used to indicate climatic conditions at a particular time? And, what do other types of evidence (e.g., carbon and other elemental isotope data) from the site indicate about past climates?

The geoarcheological data from the Firebreak site does not support any meaningful paleoenvironmental interpretations, in large part because poor temporal resolution is associated with lack of stratification and disturbances in sandy sediments. No attempt was made to obtain elemental isotope data from the Firebreak deposits because the buried A horizon observed at the site is culturally enriched and the isotopic data would not reflect the natural environmental conditions. Such studies in noncultural, off-site settings could be productive.

RETHINKING PALUXY SITE ARCHEOLOGY

Douglas K. Boyd, Gemma Mehalchick, and Karl W. Kibler

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In this chapter, recommendations of National Register of Historic Places (National Register) eligibility are presented for the three Paluxy sites investigated. A great deal has been learned about the chronology, depositional processes, and geographic distribution of Paluxy sites on Fort Hood in the past decade, and much has been learned from this project in particular. All of this information has a bearing on future archeological research.

The rest of this chapter is devoted to summarizing and reexamining current thinking about Paluxy site archeology, and the intensive investigations at the Firebreak site contribute important data to this reexamination. The first of five sections considers Paluxy site stratigraphy and geochronology in relation to models of depositional processes and site formation. The next section looks at the archeological remains—material culture and features—associated with Paluxy occupations on Fort Hood, which is followed by a discussion of the paleoenvironmental research potential of Paluxy sites and environments. The fourth section is a methodological discussion of future archeological research on Paluxy sites at Fort Hood. The final section of this chapter is a discussion of the apparent relationship between Paluxy sites and geophyte processing and what this relationship may mean for understanding prehistoric hunter-gatherers in central Texas.

SITE REEVALUATIONS

Archeological testing of three Paluxy sites on Fort Hood—41CV595, 41CV988, and 41CV1141—was carried out to reassess their research potential after they were damaged by cedar clearing or firebreak blading. More data recovery excavations were done at one site—41CV595, the Firebreak site—to mitigate some of the damage to the archeological deposits. The archeological data derived from this project allow each site's research potential and National Register eligibility to be reevaluated.

In 1986, Texas A&M University recorded 41CV988, and Mariah Associates, Inc., shovel tested it in 1992 (Trierweiler, ed. 1994:A1133–1135). Prewitt and Associates, Inc. (PAI), formally tested the site in 1996, at which time it was recommended as eligible for listing in the National Register of Historic Places (Kleinbach et al. 1999:71–79). Cedar clearing damaged the site some time in 1997–1998, and Fort Hood archeologists assessed these damages in 1998 (Huckerby 1998a) and 1999 (Kleinbach 1999:12–14). The 1999 investigation suggested that the site was virtually destroyed and probably no longer eligible for listing in the National Register. Testing by PAI archeologists in 2000 (this report) indicates that cedar clearing indeed destroyed the significant archeological deposits at 41CV988. We concur that the site is no longer eligible for listing in the National Register and warrants no further archeological studies.

In 1985, Texas A&M University recorded 41CV1141, and it was revisited and monitored in 1988. Mariah Associates, Inc., tested the site in 1992, at which time it was recommended as eligible for listing in the National Register of Historic Places (Trierweiler, ed. 1994:A1280–1284). Some time in 1997–1998, cedar clearing damaged the site, and Fort Hood archeologists assessed this damage in 1999 (Kleinbach 1999:22–23). This investigation noted that much of the site remained intact and that it was probably eligible for listing in the National Register. PAI testing in 2000 (this report) confirms that there are indeed significant archeological deposits remaining at 41CV1141. We recommend that the site is eligible for listing in the National Register and warrants protection or further archeological studies.

Texas A&M University recorded 41CV595 in 1984, and A&M archeologists re-recorded and monitored it in 1985 and 1988. Mariah Associates, Inc., shovel tested the site in 1992, and Mariah archeologists formally tested it in 1993. Based on the 1993 investigation, the site was recommended as eligible for listing in the National Register (Abbott and Trierweiler, eds. 1995a:472–483).

Bulldozing to create firebreaks to control a massive range fire in February of 1996 damaged the site. Fort Hood archeologists assessed these damages in 1998 (Huckerby 1998). Noting that intact cultural deposits were likely present, they recommended that a recovery plan be developed. Testing and data recovery by PAI in 2000 (this report) recovered a great deal of significant archeological data, but it was only partial data recovery work done specifically to mitigate some of the damage from the firebreak blading and was not intended as a complete mitigation of the site's research potential. Thus, if any archeological deposits remain intact, the Firebreak site is still eligible for listing in the National Register. The current investigations confirmed that this is indeed the case, and substantial intact archeological deposits are likely to remain in many areas of the site. It is recommended that 41CV595 is National Register eligible and warrants protection.

The Firebreak site is quite large, covering some 16,250 m^2 (130x125 m). The entire area that has been hand excavated is only about 40 m^2 (i.e., Mariah test units at 3.5 m^2 and Prewitt test units at 35.7 m^2), and it is estimated that only about 130 m^2 of backhoe trenches (i.e., Mariah trenches at ca. 57.6 m^2 and Prewitt trenches at 71 m^2) have been dug. Thus, the combined excavations account for less than 1 percent of the site's total surface area. Previous tank traffic, erosion, and firebreak bulldozing destroyed an unknown amount of the upper deposits, but the excavations confirm that there are intact deposits over much of the site. As shown in Figure 9.1, there are four particular areas that are likely to have the greatest research potential:

- the northern edge of site, around Area 1;
- the area immediately around Area 2, including a 40-m-long stretch immediately downslope (east) of Area 2;
- the remaining portion of the burned rock mound in Area 3; and,
- the southern edge of the site (called Area 4), especially the area underneath the brush and sediment piles created by the 1996 firebreak blading.

Although it is impossible to quantify the volume of intact cultural deposits accurately, it is reasonable to assume that there are several thousand cubic meters of intact sediments containing cultural remains in these areas. The southern area alone could easily have more than a thousand cubic meters of intact cultural deposits protected beneath the piles of bladed debris.

PALUXY SITE STRATIGRAPHY, GEOCHRONOLOGY, AND DEPOSITIONAL PROCESSES

Paluxy sites rest on the sandy deposits of the Paluxy Formation or are encapsulated in late Quaternary colluvial and sheetwash or rillwash sediments derived from the Paluxy and overlying Walnut formations. These sandy sediments are pedogenically altered and form a varied soil catena across each site because the topography and ages of the deposits differ.

The current investigations at 41CV595, 41CV988, and 41CV1141 did not produce or yield any data that contradict earlier interpretations of soil stratigraphy, geochronology, and depositional processes at Paluxy sites (see Abbott and Trierweiler 1995a; Kibler 1999) to any great degree. Throughout the late Quaternary, sandy Paluxy deposits were subject to cycles of gully formation and erosion, deposition, and soil formation.

Abbott and Trierweiler's (1995a) and Kibler's (1999) studies of Paluxy sites show that colluvial and sheetwash or rillwash deposition was and continues to be important in forming these sites and a significant means of site burial. Kibler (1999) also noted that many Paluxy sites appear to be nothing more than an accumulation of late Quaternary colluvial and sheetwash or rillwash sediments derived from the Paluxy Formation outcrop. Based on current observations at 41CV595 and 41CV988, however, some Paluxy sites–particularly the upper slopes of

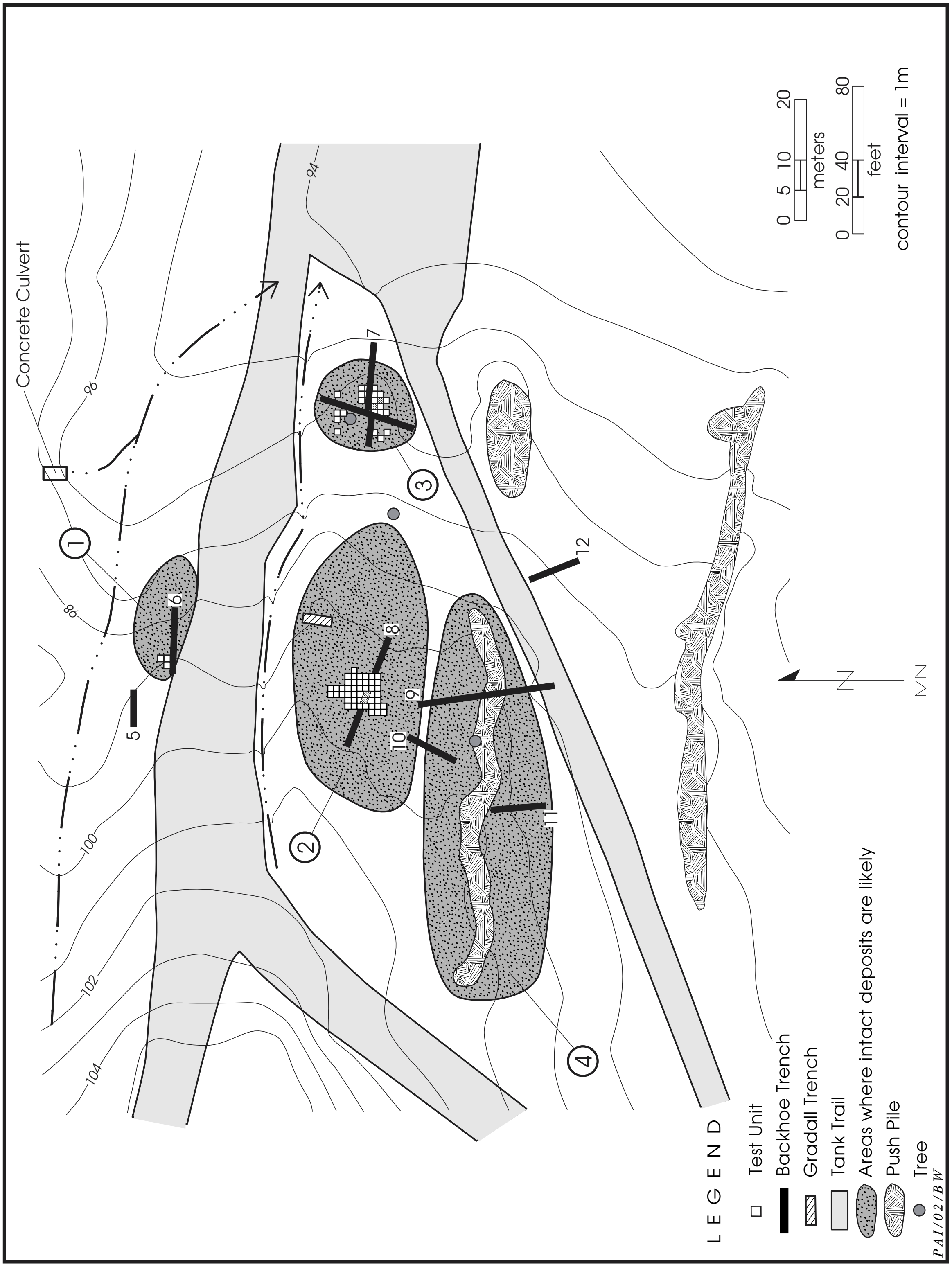

Figure 9.1. Site map of 41CV595 showing areas where intact archeological deposits are likely.

some sites–are in fact a highly weathered but intact Paluxy Formation sand.

In general, two stratigraphic units can be discerned at most Paluxy sites. Kibler (1999) designates these Strata I and II. Stratum I is late Holocene and is archeologically significant because it contains the cultural features and artifacts found at Paluxy sites. Based on radiocarbon assays, primarily from buried cultural features, Stratum I accumulated between ca. 3500 and 500 B.P. at most Paluxy sites. Stratum I is typically less than 50 cm thick and pinches out downslope, although Stratum I sediments more than 100-cm-thick are not uncommon in old erosional gullies. The sediments are typically dark loamy sands to sandy loams imprinted with A soil profiles. Thicker deposits typically display A-E or A-Bw soil profiles. The contact between Strata I and II is abrupt to very abrupt and wavy.

The age of Stratum II is not known, although it is fairly clear that it was truncated by ca. 4000–5000 B.P. Because no in situ cultural materials and features have ever been recovered from the preserved portions of Stratum II, it is believed that Stratum II started to accumulate during the late Pleistocene. Depending on slope location, Stratum II may rest on the Glen Rose limestone or on Paluxy sandstone. A well-developed truncated Bt horizon, which is usually a red (2.5YR and 5YR hues) well-structured sandy clay loam, marks the top of Stratum II. The Bt horizon is more readily preserved on the lower slopes of Paluxy sites, where it is relatively thin and rests directly on the Glen Rose limestone or sometimes on a late Pleistocene caliche. On upper slopes where Stratum II has not been completely removed by erosion, the deposit is usually thicker, and the Bt horizon overlies a BC horizon, which is typically a brown (7.5YR and 10YR hues) sandy loam to sandy clay loam. It is on the upper slopes that the truncated Bt or Bt-BC soil of Stratum II rests on slightly weathered to unweathered sands of the Paluxy Formation. In some cases, however, this soil does not represent a distinct depositional unit at all but is imprinted on intact sediments of the Paluxy Formation.

Surface flow in the form of sheetwash or rillwash and raindrop impact (Kibler 1999:55) appears to dominate the late Quaternary deposition of sands derived from Paluxy Formation outcrops. Mass wasting was also probably an important depositional process in the early formation of many Paluxy sites. Although the sandy deposits of Strata I and II are easily eroded, as the gullied and truncated surface of Stratum II and recent disturbances to the sandy Stratum I mantle show, aggradation and an overthickening of these sandy deposits may enhance infiltration, consequently hampering surface flow and slowing erosion. This phenomenon may explain why the well-developed Bt horizons of Stratum II are predominantly preserved on the lower slopes as the erosive energies of surface flow wane because of infiltration upslope. Ultimately, however, two factors condition formation of a Paluxy site—the presence of relatively thick Paluxy Formation outcrops, usually greater than 3 m, occurring above low-gradient Glen Rose limestone slopes, which promote accumulation of colluvial and sheetwash and rillwash sediments. These factors coexist throughout the west-central portion of Fort Hood, primarily north of House Creek, south of Shell and Manning Mountains, and west of West Range Road to the western boundary of Fort Hood. The distribution and nature of the Paluxy sand islands, and the archeological remains they contain, have important implications for understanding prehistoric land-use patterns.

PALEOENVIRONMENTAL POTENTIAL OF PALUXY SITES

Earlier investigations at Fort Hood noted the unique Paluxy environment and the intentional selection of Paluxy sand accumulations as habitation spots by prehistoric peoples (Trierweiler 1994; Abbott and Trierweiler 1995a). Clearly, the presence of large pockets of well-drained sandy soils within vast areas dominated by limestone bedrock is unusual in the Edwards Plateau. Because these locations were far away from the main river and stream channels, they afforded an opportunity for foragers to camp closer to subsistence resources in the limestone uplands. These sandy pockets also may have supported a distinctive floral community that offered abundant subsistence resources not found in other settings on Fort Hood. Abbott (1995c:816) suggested that prehistoric peoples sought and used this environmental setting. His idea is supported by the fact that the Paluxy substrate, although it makes up a very small percentage of the Fort Hood landscape, contains an inordinately large number of archeological sites. Also, the presence of burned rock features within sandy deposits where limestone does not occur naturally demonstrates that the occupants purposefully selected the Paluxy substrate for various activities, as "it is the only explanation for the physical labor required to transport considerable volumes of rock to the sites (Abbott 1995c:816)."

Given these interpretations, what were the characteristics of this environment? Its selection and use by prehistoric hunter and gatherer populations suggest that a specific resource or suite of select resources was being exploited. To determine what resources were used, it is important to have some understanding of environmental conditions when people occupied Paluxy sites.

There are various methods and techniques for reconstructing or interpreting past environments. Geological and pedological studies of the Paluxy sites have given us a partial portrait of what the past environment may have been like, and other methods may bring this picture into sharper focus. Studies of animal bones, fossil pollen, and plant phytoliths are three traditional avenues of research that can be pursued in the quest for paleoenvironmental information. All three, however, have limited practicality and success in open-air sites in central Texas. High pH levels (highly alkaline), oxidation, and extreme wetting and drying cycles characterize central Texas soils, and such conditions are not conducive to preserving bone, pollen, or phytoliths. The same conditions generally prevail in Paluxy soils, although they tend to be less alkaline and range from mildly acidic (6.1 pH) to moderately alkaline (8.4 pH) according to the Coryell County Soil Survey (Cisco soils as described in McCaleb 1985:Table 14). One of the more viable and potentially fruitful methods of paleoenvironmental research for Paluxy sites is isotopic chemistry, particularly measuring stable carbon ($^{13}C/^{12}C$) ratios of soil organic matter.

The $^{13}C/^{12}C$ ratio, expressed as d^{13}C, of soil organic matter can be used to interpret the composition of past plant communities—a proxy of climatic conditions—because different plants use ^{13}C and ^{12}C in different ratios during photosynthesis (Dzurec et al. 1985; Haas et al. 1986; Nordt 2001). This isotopic difference is reflected in the organic matter of the soil, which supported the vegetation, and can be measured by mass spectrometer.

Unlike ^{14}C, the ^{12}C and ^{13}C isotopes are stable and do not decay. During photosynthesis, a plant uses CO_2 consisting of ^{14}C, ^{13}C or ^{12}C (the amount of atmospheric ^{14}C is very little compared to the atmospheric content of the two stable isotopes). Plants employ one of two photosynthetic pathways that use the stable isotopes in different ratios. Plants of the C_3 group use the Calvin-Benson photosynthetic pathway, which produces a three-carbon molecule (phosphoglycerate), and C_4 plants use the Hatch-Slack pathway, with a four-carbon molecule (oxaloacetate, aspartate, or malate) as the first stable product of CO_2 fixation. A third group, the Crassulacean acid metabolism (CAM) plants, includes most succulents and can operate as a C_3 or C_4 plants, depending on the environmental conditions.

Most trees, shrubs, and cool-season grasses are C_3 plants, but most warm-season grasses and herbaceous plants are C_4. The C_4 or Hatch-Slack photosynthetic pathway efficiently uses more of the available carbon (in the form of CO_2), but the Calvin-Benson pathway or C_3 plants use less of the available carbon because it discriminates against ^{13}C (O'Leary 1981). This difference makes C_4 plants more tolerant of droughts, high temperatures, and high irradiances but less tolerant of cold temperatures, especially minimum temperatures during the growing season (Tieszen and Imbamba 1980). Consequently, d^{13}C values of soil organic matter will reflect the C_3-C_4 plant composition of the floral community alive at the time, which in turn reflects climatic conditions, such as mean annual temperatures and precipitation (see Teeri and Stowe 1976; Livingston and Clayton 1980; Cerling and Hay 1986).

The measurement of d^{13}C is calibrated from the $^{13}C/^{12}C$ ratio in a marine belemnite (*Belemnitella americana*) from the Cretaceous Peedee Formation of South Carolina (Craig 1953). Known as the PDB standard, this fossilized mollusk has a tremendous amount of ^{13}C in relation to ^{12}C and is used as the zero reference point for measurements of d^{13}C. Most terrestrial sources such as living plants have much less ^{13}C, resulting in negative numbers compared to the PDB standard.

The difference between the PDB standard and the d^{13}C of a given sample is expressed in parts per thousand (mil) or ‰. C_3 plants have much less ^{13}C, and their average d^{13}C value is approximately -27 ‰; but C_4 plants have more ^{13}C, and their average $d^{13}C$ value is near -13 ‰ (Cerling et al. 1989:138).

The $d^{13}C$ values on soil organic matter from Paluxy site soils have shed some light on the nature of the plant community supported by the Paluxy substrate. Buried soils (A horizons) have been observed in Stratum I at five Paluxy sites (41CV947, 41CV984, 41CV988, 41CV1106, and 41CV1258, see Kibler 1999:57), and these soils provide the ideal setting for taking sediment samples for stable carbon isotope analysis of organic matter. Kibler (1999:57) obtained a $d^{13}C$ value on soil organic matter in association with a radiocarbon age (2210 ± 60 B.P.) from a buried soil at one of these sites (41CV1258). The soil humates produced a $d^{13}C$ value of –19.7 ‰, suggesting that an estimated 48 percent of the plant biomass consisted of C_3 plants during the late Holocene. This percentage implies a tree-covered landscape, and one can envision a woodland or parkland plant community in which the arboreal canopy cover is less than 50 percent. Future research should include analyses of sediment samples taken from noncultural (or offsite) buried soils so that the isotope data reflects the natural environment.

Modern observations suggest that interpreting a woodland or parkland savannah-like environment for Paluxy deposits on Fort Hood during the late Holocene is plausible. Because the Paluxy sand accumulations have limited spatial distributions, they appear to exhibit a flower-pot effect in which clusters of trees and other vegetation thrive. Compared to the limestone slopes where much of the rainfall simply runs off, the sandy Paluxy soils tend to soak more of the rainfall and make it available for the plants.

To the north of Fort Hood, the Paluxy Formation is more extensively exposed and supports the eastern portion of the Western Cross Timbers environment (Hill 1901:166). The Western Cross Timbers is an appropriate ecological model for understanding the paleoenvironment and resource base and structure of Paluxy sites on Fort Hood. Generally, the Western Cross Timbers is an ecotone where the underlying geology and soils give rise to vegetation that contrasts with the adjacent, highly calcareous formations.

"Without exception, the narrow belts of Paluxy sand outcrops support a growth of hardwoods, forming ribbons of woodland in an area where grasses would normally predominate" (Texas State Historical Association 1997–2001). "The combination of grassland and woodland, with its many miles of grassland-timber border, and the added influence of streams and rivers crossing the vegetation bands, provides a remarkable variety of habitats for plant species and animal life hardly excelled anywhere in the mid-continent prairie" (Costello 1969).

The recovery and analysis of charred botanical remains supports these observations and provides more clues about the floral community situated on and in the vicinity of the Paluxy Formation during prehistoric times. To date, the ethnobotanical analysis of charcoal and processed flotation samples retrieved from Paluxy sites has identified 22 wood taxa (Table 9.1). Some typically riparian hardwoods–for instance ash, pecan, sycamore, walnut, and willow–would flourish along moist stream bottoms situated downslope of the Paluxy sites. Although none of the identified wood taxa are specific to the sandy Paluxy sediments, these surfaces would have supported the hallmark of the Cross Timbers—the post oak—which still grows on most Paluxy sites (including Firebreak). The thin soils on upland limestone surfaces and slopes support xerophytic specimens such as juniper, persimmon, sumac, and some of the oaks.

Oak wood is the most common taxon represented in the Paluxy site samples, and Dering (1998b:1629–1630) has stated that "both oak and juniper are preferred fuel…and preserve well and are easily identified, even in a very deteriorated state." Surprisingly only Features 3 and 4 (cooking pits) at 41CV1553 have produced a minimal amount (19 g) of juniper wood. These findings suggest that other woods were favored or easily attainable or that juniper was not as widespread or densely populated across the prehistoric landscape as it is today.

Growing conditions for the two recognized geophytes—eastern camas and wild onion—are similar (Cheatham and Johnston 1995:210–211; 2000:514). *Allium drummundi* (the most common onion species in central Texas) and *Camassia scilloides* both prefer full sun to part shade in open areas (i.e., little or no canopy), and they thrive in calcareous prairie soils but can tolerate sandy conditions or moderately alkaline soils such as those common in Coryell County (McCaleb 1985:Table 14). Over the past several years at Fort Hood, eastern camas

Table 9.1. Wood taxa identified at Paluxy sites

Taxon	Common Name
Acer sp. Maple	Maple
Acer negundo Boxelder	Boxelder
Carya sp.	Hickory
Carya illinoensis	Pecan
Celtis sp.	Hackberry
Cornus drummondii	Rough-leaf dogwood
Diospyros sp.	Persimmon
Fraxinus sp.	Ash
Ilex sp.	Holly
Juglans sp.	Walnut
Juglans nigra	Black walnut
Juniperus sp.	Juniper
Morus sp.	Mulberry
Platanus sp.	Sycamore
Quercus sp.	Oak
Rhus sp.	Sumac
Robinia pseudo-acacia	Black locust
Rosaceae	Rose family
Salicaceae	Willow family
Salix sp.	Willow
Sapindus saponaria	Soapberry
Ulmus sp.	Elm

Note: From Dering 1995, 1999, 2001.

and wild onion have been observed on upland limestone surfaces and sandy to chalky slopes in limited quantities (Laura Sanchez, personal communication 2001; personal observations 2000–2002). But several large patches of eastern camas have been noted in moist swales and bottomlands in Texas (Cheatham and Johnston 2000:521). As discussed later in this chapter, the modern occurrences (both spatial distributions and abundance) of wild onions and eastern camas across Texas are misleading, and these plants were probably much more common in early historic and prehistoric times.

Continued recovery and identification of charred macrobotanical remains from cultural features, in conjunction with stable carbon isotope studies, are probably the most viable techniques to obtain paleoenvironmental data and aid in reconstructing the prehistoric Paluxy environment on Fort Hood. This research also would provide valuable information about mobility and landscape use. It is important, however, that sediment samples for stable carbon isotope study be derived from noncultural contexts–on the extreme margins of or away from habitation sites–so that the resulting data reflect the natural environment. Dating buried noncultural deposits might be enhanced by using the optically stimulated luminescence (OSL) technique.

ARCHEOLOGICAL REMAINS IN THE PALUXY ENVIRONMENT

In terms of prehistoric human occupations, the restricted distribution of Paluxy sand accumulations means that this setting was unique in many ways (see Chapter 8). The islands of sand were attractive as camps or short-term residential locations, and understanding what people did at these sites and why they came there are important considerations in any organic approach to landscape archeology. The archeological remains buried in the Paluxy sands hold the key to these questions, but the very nature of site formation imposes some limitations on interpreting those remains. These limitations are discussed at length in Chapter 8, but there are two important points worth reiterating. Because cultural remains in Paluxy deposits generally lack natural and cultural horizontal stratification, sorting the artifacts into meaningful assemblages that represent discrete occupation episodes was not possible at Firebreak and will not be possible at most other Paluxy sites. And the most significant archeological data obtained from the Firebreak data recovery project were derived from investigating the features rather than the artifacts.

Previous archeological testing of Paluxy sites has been productive, but as was true at Firebreak, it is the features at these sites rather than the artifacts that have provided the most meaningful evidence of past human activities. This is in part because previous testing emphasized finding and assessing the research potential of cultural features as part of site evaluation. But it also reflects the reality of what can be done with small artifact samples from low-volume archeological testing. As summarized in Table 9.2, the artifacts and features found in the Firebreak data recovery work constitute the largest and most interpretable assemblages yet unearthed from a Paluxy site.

The features found during previous testing of various Paluxy sites have frequently provided meaningful archeological data. All of the features commonly found on Paluxy sites contain or consist primarily of burned limestone rocks (see Kleinbach et al. 1999: 385–392; Tables 83

Table. 9.2. Summary of artifact assemblages and features found at Paluxy sites on Fort Hood

Site	Fort Hood ARMS Research Report No.	Reference	Volume of Hand Excavation (m^3; all projects*)	Buried Features (all projects*)	Previous Projects*		This Project		Total No. of Stone Tools per m^3 (all projects)
					All Artifacts	Stone Tools	All Artifacts	Stone Tools	
41CV0319	34	Abbott and Trierweiler 1995a: 450–459	2.80	2.00	38.00	1.00	–	–	0.36
41CV0478-A	35	Trierweiler, ed. 1996:Table 5.64	2.70	2.00	43.00	4.00	–	–	1.48
41CV0594	31	Trierweiler, ed. 1994:205–274, A961–A964	1.55	4.00	55.00	9.00	–	–	5.81
41CV0595	34	Abbott and Trierweiler 1995a: 472–483; this report	39.20	16.00	490.00	18.00	3,394	123	3.60
41CV0947	38	Kleinbach et al. 1999:59–65	3.10	3.00	148.00	8.00	–	–	2.58
41CV0984	38	Kleinbach et al. 1999:65–71	2.60	2.00	415.00	14.00	–	–	5.38
41CV0988	38	Kleinbach et al. 1999:71–79; this report	10.65	5.00	544.00	17.00	156	13	2.82
41CV1023-A	34	Abbott and Trierweiler 1995a: 532–543	1.59	4.00	219.00	6.00	–	–	3.77
41CV1027	34	Abbott and Trierweiler 1995a: 543–551	5.50	4.00	121.00	6.00	–	–	1.09
41CV1049-A	38	Kleinbach et al. 1999:83–90	3.30	2.00	108.00	9.00	–	–	2.73
41CV1093	38	Kleinbach et al. 1999:94–100	2.50	3.00	251.00	9.00	–	–	3.60
41CV1106	38	Kleinbach et al. 1999:100–104	3.10	3.00	37.00	6.00	–	–	1.94
41CV1138	38	Kleinbach et al. 1999:104–111	3.80	2.00	140.00	15.00	–	–	3.95
41CV1141	31	Trierweiler, ed. 1994:A1280–A1284; this report	6.05	8.00	125.00	2.00	521	30	5.28
41CV1143-A	38	Kleinbach et al. 1999:111–115	2.30	2.00	3.00	1.00	–	–	0.43
41CV1191-y	38	Kleinbach et al. 1999:116–124	1.00	1.00	1.00	0.00	–	–	0.00
41CV1391-C	38	Abbott and Trierweiler 1995a: 642–652	2.80	2.00	240.00	11.00	–	–	3.93
41CV1403	34	Trierweiler, ed. 1996:478–485	0.80	3.00	95.00	5.00	–	–	6.25
41CV1415	50 (draft)	Mehalchick and Kibler 2002:77–83	12.88	8.00	410.00	15.00	–	–	1.16
41CV1553	44	Mehalchick, Killian, et al. 2003:Table 6.1	3.37	5.00	53.00	11.00	–	–	3.26
Total No.			111.59	81.00	3,536.00	167.00	4,071	166	59.42
Average per site			5.58	4.05	176.80	8.35	–	–	2.97
Stone tools as percentage of all artifacts						4.72%		4.08%	

* Data on excavation volumes, artifacts, and partially or wholly buried features from previous projects are summarized in Boyd et al. (2000:Appendix B).

and 85). Many of these features are obviously intact and retain a high degree of patterning representing intentional placement of the rocks for specific purposes. Such features have three main advantages over the scattered artifacts when it comes to interpreting human behavior. Intact features represent discrete events that translate directly into behavioral interpretations (e.g., a cooking episode), often contain charred organic remains that are directly associated and can be radiocarbon dated to determine when the event took place, and often contain charred organic remains that can be identified to provide further evidence of feature function. Identifying the charred organic remains often determines the types of woods burned as fuel and the types of plants that were cooked and eaten.

In contrast to the features, the artifacts found during previous Paluxy site testing projects have been much less interpretable. This is, quite simply, because small sample sizes limit interpretation. The number of artifacts recovered from the Firebreak site alone (3,884 from all phases) surpasses the number of artifacts found during all testing projects at 19 other Paluxy sites combined. With stone tools accounting for only 4 to 5 percent of the total artifacts at any given Paluxy site, the importance of sample size becomes clear. The 123 stone tools from Firebreak data recovery excavations is still a small sample, but this tool assemblage is sufficiently large to interpret some aspects of human behavior (see Chapter 8) and is the largest excavated tool sample from a single Paluxy site. In contrast, the next largest single-site assemblage contains only 17 stone tools. Although the number of stone tools per cubic meter varies from about 0.4 to 6.3, the average recovery rate for Paluxy sites is about 3 stone tools per cubic meter of excavation. Obviously, a sizable excavation area is needed if one of the research goals is to obtain a stone tool assemblage that approximates a random sample and is large enough to support behavioral interpretations reasonably. Because of the small samples, the other Paluxy site artifact assemblages from previous testing provide little meaningful information when compared with the Firebreak assemblage.

FUTURE ARCHEOLOGICAL RESEARCH ON PALUXY SITES

Since Paluxy sites were first recognized as a distinct class of archeological site on Fort Hood beginning in 1991 (Abbott 1994:327), we have learned much about these places. To date, 37 Paluxy sites have been recorded, and 19 of these are considered eligible for listing in the National Register of Historic Places (Figure 9.2). Data summarized from reconnaissance, shovel testing, and National Register testing of these 37 sites are presented in Appendix E. From National Register testing and data recovery, we now better understand how to manage and investigate these important resources.

What Threatens Paluxy Sites?

Previous researchers noted that the most significant threat to all Paluxy sites is from uncontrolled military traffic, especially heavily armored tanks (see Boyd et al. 2000: 37–38). After the initial studies of Paluxy sites from 1991 to 1993, Mariah archeologists noted that, “The Paluxy soils are highly prone to sheetwash and gullying, and tracked vehicles are capable of initiating severe degradation both by mixing the matrix and the subsequent natural erosion of disturbed areas” (Trierweiler, ed. 1994:367).It is a combination of factors—such as initial soil disturbance and compaction, removal of vegetation cover, and accelerated erosion—that affects the archeological remains at the site. The Fort Hood Cultural Resources Management Program has recognized the seriousness of this threat, as well as the fact that all Paluxy sites are vulnerable. They initiated this research-oriented Paluxy site data recovery program, and they are trying different approaches to protecting the remaining National Register-eligible Paluxy sites from damage by military vehicles.

Why Are Paluxy Sites Important?

It should not be at all surprising to find that the Firebreak site must be treated as a single archeological component for analysis. We suspected that this might be the case before starting into the data recovery phase. Researchers (see Abbott 1995b:821–823; Boyd 2000:37) already recognized the inherent contextual problems of Paluxy sand sites, and it is clear that research potential of Paluxy sites will not compete directly with that of any stratified alluvial site or rockshelter. Although the Firebreak site

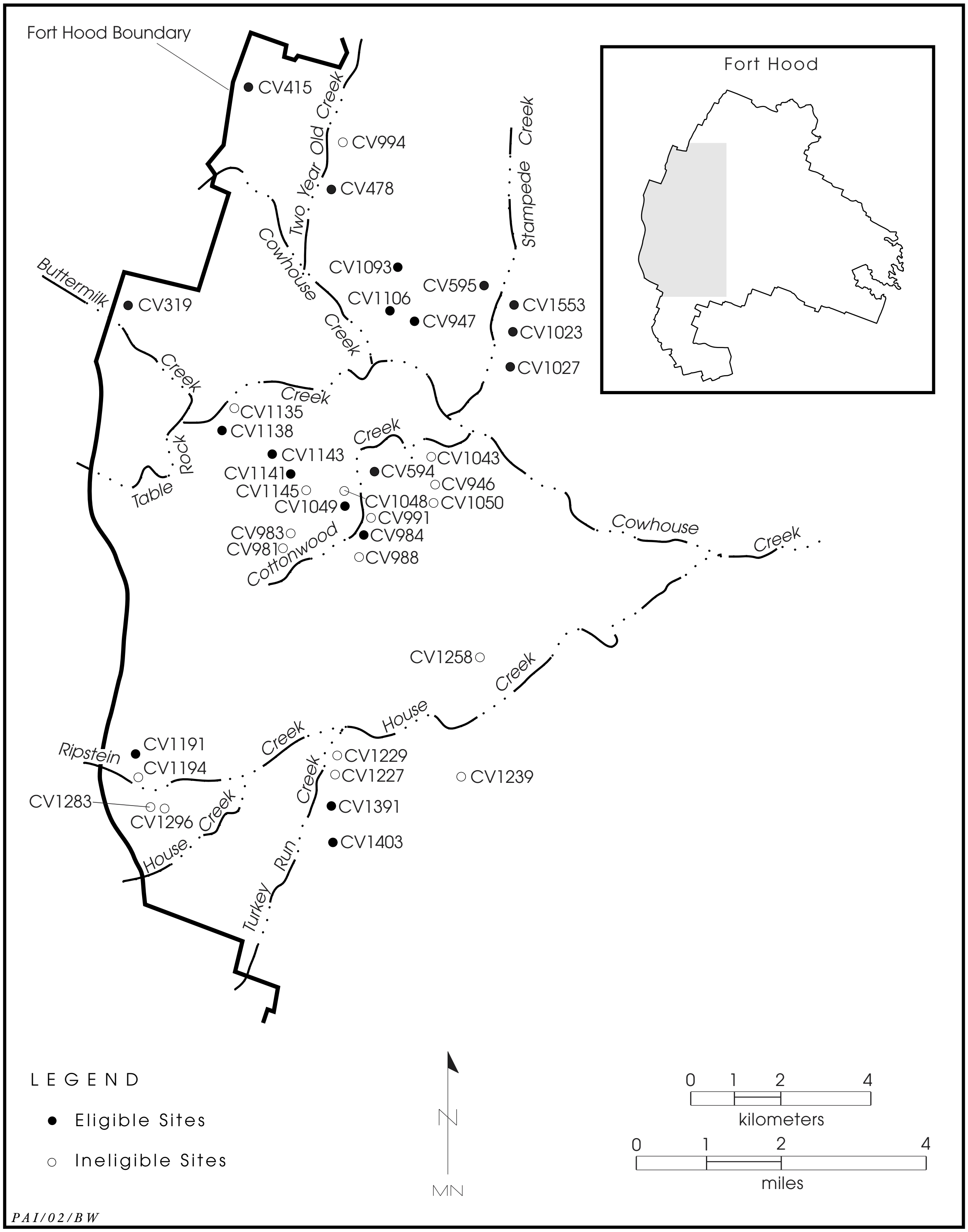

Figure 9.2. Locations of Paluxy sites on Fort Hood.

certainly does not fit Collins' (1995:374) definition of a *gisement* (i.e., a site with stratified archeological layers), it is far from being a meaningless palimpsest unworthy of investigation. The Paluxy environment is unique on Fort Hood, and Paluxy sites contain archeological evidence that is significant from many perspectives. Digging all of the stratified rockshelters and alluvial sites on Fort Hood will not answer the important questions about why people came to camp on Paluxy sand accumulations on the Killeen surface.

Paluxy sites have great research value and represent a unique setting on the landscape, but we are only now beginning to get some ideas about the complexity of these locations. Understanding the prehistoric activities on Paluxy sites can come about only through detailed archeological excavations and research-oriented analyses. As a distinct class of archeological locations, Paluxy sites are not without their inherent contextual problems. The sediments encapsulating the cultural remains are poorly stratified at best and more regularly lack any meaningful stratigraphy. The sandy deposits represent weathered Paluxy sands concentrated on relatively stable surfaces reworked by slopewash and extensive bioturbation. The sandy deposits are generally thin–usually less than a meter thick–and usually contain compressed materials representing a fairly long time span.

Even the deeper, gully-filling deposits may be extensively reworked, although this has not been fully demonstrated yet. None of these conditions are conducive to preserving detailed horizontal and vertical artifact patterning, and separating materials into short-duration cultural components is virtually impossible. Bone preservation is generally poor, but charred macrobotanical remains have proven better preserved. Intact features representing discrete cultural activities are common and often contain well-preserved organic remains.

Despite the many contextual cautionary notes, we are missing out if we exclude Paluxy sites from research. If our ultimate goals are a total understanding of landscape use at Fort Hood, the Lampasas Cut Plain, and throughout central Texas, then ignoring Paluxy sites because they have some contextual problems is not the answer. There are clearly many important regional research questions that can be answered only through archeological investigations at Paluxy sites.

Previous ideas about why native peoples chose to occupy the Paluxy locations centered on the sandy substrate and a possible floral community unique to this area (Abbott 1994, 1995; Boyd et al. 2000; Kleinbach et al. 1999). The idea that people were attracted to nearby plant resources was bolstered by the recovery of unidentifiable geophytes from pit features encountered during formal testing over the past several years (Kleinbach et al. 1999; Mehalchick, Killian, Caran et al. 2000). The wild onion and eastern camas bulbs recovered from Firebreak support this hypothesis, but neither plant is found solely in sandy areas. The presence of pecan nut fragments and oak acorns at Firebreak and five other Paluxy sites also provide evidence of other important plant foods. Clearly, access to the upland prairie, pockets of oak savannah, and the riparian woodlands—all within a relatively short distance (in many cases within a few kilometers)—would offer an unparalleled combination of resources.

The current Fort Hood data still support the interpretation that Paluxy sites represent seasonal plant-processing centers, with occasional hunting or mussel-gathering forays. As Thoms (1989:254) notes, "Processing camas at or near the procurement site, however, was practical only to the extent that the essential raw materials—fuel, rocks, and packing materials—required for building and using earth ovens . . . could be found locally." He also includes water as a resource often needed in cooking, although water was "not always noted as a required component of an earth oven" in the ethnographic accounts. Thus, when prehistoric peoples selected the Paluxy sands, it was certainly a conscious choice of a good camping spot that was centrally located to all of the necessary resources required for the primary task of plant processing. The well-drained, easy-to-dig sandy soils and nearby rocks were undoubtedly important considerations, but it was the abundance of plant foods nearby that was the single most critical factor.

Using only the data from the Firebreak site, many of the research questions posited in Chapter 1 were addressed in Chapter 8. Some questions in six of the seven broad categories—chronology, site formation, lithic strategies, subsistence technologies and resources, and site function—were addressed, but few contributions were made to the sixth category—paleoenvironmental reconstructions. Although a considerable amount of data from formal site testing and data recovery at Firebreak contributes to the broad research goals, block excavations at one site alone cannot fully address all of the issues that were raised. Intensive archeological research on many more Paluxy sites is needed before we can be confident about the broad interpretations.

How Should We Investigate Paluxy Sites?

This project demonstrates that there is much to be learned from data recovery at Paluxy sites. From a methodological standpoint, the work at the Firebreak site confirms the importance of excavating large areas and contiguous-unit blocks to increase tool sample size and locate and investigate multiple cultural features and activity areas. It also shows the utility of taking extensive flotation samples from feature contexts to increase the chances of recovering preserved plant remains that may define prehistoric activities, and obtaining multiple radiocarbon assays to determine when those activities occurred. These techniques were recommended for Paluxy site investigations in 1994 (Trierweiler, ed. 1994:366–367), and we also consider them to be the most appropriate techniques for future investigations.

In many ways, a Paluxy site must be thought of in the same way that we think of a burned rock midden. A typical midden has thick deposits of cultural matrix (burned rocks and artifacts) that represent a long period, often many hundreds or even thousands of years. Typical midden deposits are unstratified and seriously jumbled, and the material culture is virtually impossible to separate into meaningful temporal or cultural groups. Within the middens, however, are recognizable features—clusters of rocks, sediment, and artifacts—that represent brief human activities. These same characteristics apply to Paluxy sites. The artifacts recovered from unstratified Paluxy sands are of general interest, of course, but it is the discrete features that are most important because the activities they represent may be identified, dated, and more fully interpreted. From a methodological standpoint, this means that archeological investigations at Paluxy sites must be oriented toward excavating larger areas to find, excavate, date, and interpret lots of features. Previous testing at Paluxy sites and data recovery at Firebreak supports the notion that we learn most from the discrete and intact cultural features. They are generally the only place where identifiable organic remains are preserved, and radiocarbon dates on these remains provide the chronological framework that is essential to reconstructing prehistory. Without discrete features and datable organic remains, we are simply left with artifact assemblages of tenuous ages assumed from the presence of specific styles of projectile points.

Thinking critically about the findings in this report leads us, quite naturally, to speculate about the nature of the human occupations at Firebreak, in particular, and at Paluxy sites in general. It also leads us to wonder what human activities and behaviors may have occurred at Firebreak and other Paluxy sites that we are not seeing in the archeological record. Paluxy sites are considered one type of prehistoric camp or campsite within the site typologies for Fort Hood (Boyd et al. 2000) and central Texas (Collins 1995:Table 1). These words often connote camping out in the open without any shelter (i.e., an open campsite), but no such meaning is intended (see Collins 1995:363). Although we may call them camps, there is no intent to suggest that no dwellings were present. If our interpretations of seasonal use are correct, people living at Firebreak and other Paluxy sites had to endure, at a minimum, periodic spring thunderstorms and frigid autumn temperatures. It seems unlikely that people lived at Paluxy sites without having some type of dwelling, however ephemeral those houses might have been.

At the Firebreak site, a concentration of unusually large and mostly unburned rocks was found at the north end of the Area 2 excavation block. Called Feature 16 (see Chapters 7 and 8), these large rocks are not natural occurrences in the place where they were found, and they definitely represent manuports brought there by people for some purpose. In the field, the first reaction was that they were probably part of some type of dwelling or ephemeral domestic structure situated just beyond the main cooking area. Special attention was paid to investigating this possibility. Unfortunately, and as is often the case, this tantalizing feature was encountered at the very end of the excavations at Firebreak, and critical adjacent areas could not be investigated. Consequently, no definitive conclusions could be made about the function of Feature 16, but it is possible the rocks were used as post supports or weights along the walls of some type of structure such as a windbreak, a small hut, or a larger house. The material culture, evidence of seasonal use, and subsistence activities at Firebreak all suggest that people there were likely to have lived in small brush huts or ephemeral houses, perhaps resembling the larger circular prehistoric houses found elsewhere in central Texas. The possibility of discovering habitation dwellings adds yet another dimension to the research potential for Paluxy sites and warrants some additional thought.

Prehistoric houses have been found across much of central Texas (Figure 9.3) and are reported by many researchers (Hixson 2001, 2002; Garber 1987; Garber et al. 1983; Johnson 1994, 1997; Lintz et al. 1995; Patterson 1987; P. Skinner 1971; Treece et al. 1993a, 1993b; and Tunnell and Newcomb 1962). Johnson (1997:56–62) provides the most succinct summary of archeological evidence for prehistoric houses in central Texas. Although a few prehistoric houses or huts in central Texas have circular or arc-shaped patterns of post holes, most have no obvious post holes and may be characterized as "circular houses with clusters of stones that once surrounded wall posts" (Johnson 1997:61). In some cases, structures are evidenced by post holes, but more commonly they are only represented by clusters of large stones that form roughly circular patterns around a central fireplace or cooking hearth (ranging between 1 and 3 m in diameter). Many of these houses are fairly large, generally ranging between 3 and 5 m in diameter, but smaller structures without hearths also occur. A 3-m-diameter structure at the Millican Bench site in Travis County consisted only of a crude ring of large rocks with no central hearth and was interpreted as a small wickiup-like hut (Johnson 1997:60). Certainly there is much variability in prehistoric structures in central Texas, but any groupings of large rocks that could not have been deposited naturally are suspect.

In all likelihood, prehistoric houses and other domestic features are probably greatly underrepresented in the central Texas archeological record for two primary reasons. First, they are subtle features that are difficult to recognize, especially in sites dominated by scattered burned rocks and hearth features. And second, most archeological excavations are far too small to allow individual structures to be recognized, much less allow for the identification of village patterns created by multiple structures and activity areas. Indeed, Johnson (1997:179) notes that central Texas sites with prehistoric structures are extremely important and should be investigated with "very large-scale excavations of the most modern and technical sort." Collins (1995:373) notes that "wide area excavations" are responsible for the discovery of most of the prehistoric structures in central Texas. He goes on to state that "The nature and functions of domestic structures has been one of the more neglected topics in Central Texas archeology . . . ."

Feature 16 at the Firebreak site may or may not represent an ephemeral structure, but this unusual feature definitely represents some type of behavior that is not understood and has not been recognized at other Paluxy sites. Odd features such as this, although perplexing and sometimes not fully interpretable, hint at the complexity of human activities associated with prehistoric settlements. The Firebreak experience suggests that the goals of any future archeological research at Paluxy sites should include examining internal site structure and defining horizontal activity patterns on a broad scale, which would include searching for unusual domestic features and evidence of structures. Such an investigation might employ various types of remote sensing, such as magnetometer or ground penetrating radar surveys, followed by a large-scale excavation guided by a well-conceived data recovery plan.

UNDERSTANDING CENTRAL TEXAS HUNTER-GATHERERS

Archeological studies have shown that burned rock middens, mounds, and earth ovens are common features at Paluxy sites on Fort Hood, as they are at many other sites in central Texas. Earth ovens are closely linked to cooking plant foods, and archeologists are beginning to make the connection between earth oven cooking and specific kinds of plant foods, specifically plant root foods. The relationship between earth ovens and geophytic plants that require long-term baking has been explored (see Chapter 8),

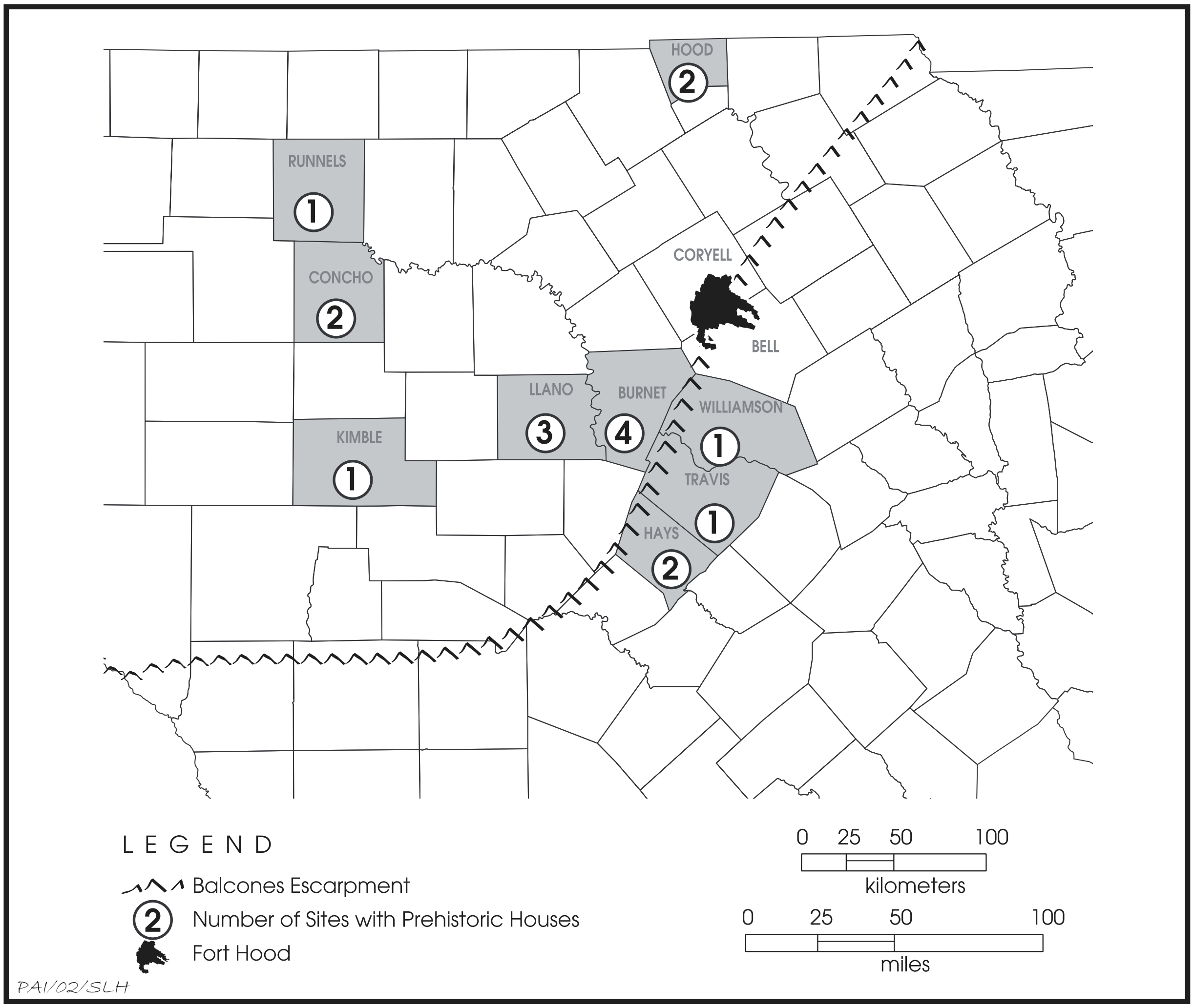

Figure 9.3. Distribution of central Texas sites where prehistoric houses have been found. Sites represented in this figure are: 41BT72, 73 and 74 (at Lake Buchanan); 41BT105, Lion Creek; 41CC112, Turkey Bend Ranch; 41CC131, Currie; 41HD42, Aiken; 41HD44, Bluebonnet; 41HY160 (at Aquarena Springs); 41HY163, Zapotec; 41KM16, Buckhollow; 41LL58 (at Lake Buchanan); 41LL78, Slab; 41LL419, Graham-Applegate; 41RN169, Rocky Branch, 41TV163, Millican Bench; and 41WM437, Rowe Valley.

and this section considers how Paluxy sites fit in with the prehistoric use of earth ovens for cooking geophytes.

In 1997, Fort Hood Senior Field Botanist Laura Sanchez compiled an inventory of vascular plants found on or in close proximity to Paluxy sites on Fort Hood, and this list is a subset of the larger list of vascular plants on Fort Hood, Texas (see Sanchez 2000). This Paluxy plant list, printed in Kleinbach et al. (1999:Table 86), is only a preliminary attempt to determine what grows in the Paluxy sands and on the thin upland soils around them. Later, discovery of corm and bulb fragments at 41CV988 and 41CV1553 (Kleinbach et al. 1999; Mehalchick, Kleinbach, Boyd et al. 2000) intensified the desire to identify plants with underground storage parts. This task was again undertaken with Sanchez's cooperation, and a list of geophytes at Fort Hood was compiled in 2000 (Table 9.3). The geophyte inventory is a comprehensive list of plants that have underground storage parts and that have been found growing on Fort Hood, but it does not differentiate species that are edible from others that may be inedible or potentially toxic. In March and April 2001, Sanchez collected specimens of 12 different species, and these were donated to Dr. Phil Dering for the Ethnobotany Laboratory's comparative collection at Texas A&M University. Five of the 12

Table 9.3. Geophytes found on Fort Hood

Species	Common name–underground storage part*
Allium canadense L. var. *canadense***	Canada garlic, wild garlic–bulb
Allium canadense L. var. *fraseri* Ownbey	wild onion–bulb
Allium drummondii Regel**	Drummond's wild onion–bulb
Androstephium coeruleum (Scheele) Greene	blue funnel-lily–corm
Anemone berlandieri Pritz. {*Anemone heterophylla* Nutt. ex Torr. & A. Gray}	wind-flower, ten-petal anemone–tuberous root stalk
Arisaema dracontium (L.) Schott***	green-dragon–corm
Callirhoe involucrata (Torr.) A. Gray	Winecup–enlarged root
Callirhoe pedata (Nutt. Ex Hook.) A. Gray {*Callirhoe digitata* Nutt. var. *stipulata* Waterfall}**	Finger poppy-mallow, standing winecup–enlarged root
Camassia scilloides (Raf.) Cory**	wild-hyacinth–bulb
Cooperia drummondii Herb.	Cebolleta, rain-lily–bulb
Cooperia pedunculata Herb**.	Giant rain-lily, prairie rain-lily–bulb
Corallorrhiza wisteriana Conrad***	spring coralroot–rhizomes
Cymopterus macrorhizus Buckley	big-root wavewing–soft woody root
Erythronium mesochoreum Knerr**	dog-tooth violet–bulb
Hexalectris spicata (Walter) Barnhart***	crested-coralroot–rhizomes
Liatris mucronata DC.**	Narrow-leaf gayfeather–corm
Muscari neglectum Guss. ex Ten. {*Muscari racemosum* (L.) Lam. & DC.}****	starch grape-hyacinth
Nemastylis geminiflora Nutt.**	Prairie celestial – bulb
Nolina lindheimeriana (Scheele) S. Watson	devil's shoestring–stem-root structure
Nolina texana S. Watson**	Sacahuista–stem-root structure
Nothoscordum bivalve (L.) Britton**	crow-poison, yellow false garlic–bulb
Oxalis drummondii A. Gray	purple wood-sorrel–bulb
Pediomelum cuspidatum (Pursh) Rydb. {*Psoralea cuspidata* Pursh}	tall-bread scurf-pea, Indian-turnip–tuberous root
Pediomelum cyphocalyx (A. Gray) Rydb. {*Psoralea cyphocalyx* A. Gray}	turnip-root scurf-pea, wand psoralea–tuberous root
Pediomelum hypogaeum (Nutt. Ex Torr. & A. Gray) Rydb. var. *scaposum* (A. Gray) Mahler {*Psoralea hypogaea* T. & G. var. *scaposa* A. Gray}**	scurf-pea–tuberous root
Pediomelum latestipulatum (Shiners) Mahler {*Psoralea latestipulata* Shinners}	scurf-pea–tuberous root
Pediomelum linearifolium (Torr. & A. Gray) J.W. Grimes {*Psoralea linearifolia* Torr. & A. Gray}	narrow-leaf scurf-pea–tuberous root
Pediomelum rhombifolium (Torr. & A. Gray) Rydb. {*Psoralea rhombifolia* Torr. & A. Gray}	round-leaf scurf-pea, brown-flowered psoralea–tuberous root
Typha sp.***	cat-tail–rhizomes
Xanthosoma sagittifolium (L.) Schott	elephant's ear–corm
Yucca arkansana Trel.	Arkansas yucca–stem-root structure
Yucca constricta Buckley	Buckley's yucca–stem-root structure
Yucca pallida McKelvey**	Pale-leaf yucca–stem-root structure
Yucca rupicola Scheele	Texas yucca, twist-leaf yucca–stem-root structure
Yucca treculeana Carr****	Spanish-dagger
Zigadenus nuttallii (A. Gray) S. Watson	Nuttall's death-camas–bulb

*Underground storage parts as defined by Diggs, Lipscomb, and O'Kennon (1999).

**Collected specimens.

***Geophytes found in riparian settings or with old growth juniper.

****Introduced species at Fort Hood; would not be found in prehistoric contexts.

species, including wild onion, were recovered on or near 41CV595 (see Table 9.3), and eastern camas was found along an upland edge about 4.5 km southeast of the Firebreak site. By no means do these findings represent the only locales for these plants, and no systematic surveys have been conducted to map out the distributions and abundance of these plants.

It has long been recognized that oak acorns, pecans, and other nuts were important food sources for prehistoric people, but it is finding geophytes in prehistoric sites at Fort Hood and elsewhere in central and southeast Texas that is of considerable interest. The archeological occurrences of charred geophyte bulbs, corms, and root fragments in Texas (see Table 8.18) shows the wide geographic distribution (Figure 9.4) and temporal span (Figure 9.5) of these finds. Of the five species that have been identified archeologically—wild onions, eastern camas, false garlic, dog's tooth violet, and rain lily—the onion and camas are the most common, and people have used them for more than 8,000 years. It is not clear whether the absence of geophyte remains during the Middle Archaic is real or not, noting that only one specimen may date to this period. This gap may be from inadequate sampling, or it could mean that the resource really was scarce and people seldom used it at the time. The Middle Archaic is often characterized as having been extremely arid, and such conditions would have limited the availability of many plant species. But both camas and onion were recovered from features dating between 5000 and 4000 B.C., another time when conditions are thought to have been very dry.

The many finds of geophytes add considerably to our knowledge of how prehistoric peoples in central Texas used these plants and how common and important these activities were. This knowledge generates much broader questions of how geophytes and other resources fit into overall hunter-gatherer subsistence patterns in central Texas. Taking this line of thought one step further, one wonders whether the native peoples harvested geophytes across the landscape as they found them or perhaps propagated the natural resources at their disposal. In the Pacific Northwest, for example, ethnographic records show that Native Americans were actively managing patches of camas and other lily family resources through selective harvesting (taking only the large bulbs and leaving the small ones for next year's crop) and use of fire to promote open grasslands where geophytes could thrive (R. Boyd 1999; Storm 2002). One may speculate that prehistoric central Texas natives had similar knowledge and also may have practiced some form of active resource management. Unlike those for the Pacific Northwest, unfortunately, there are no ethnographic records pertaining to the central Texas natives who may have used geophytes intensively because Plains Indian immigrants in Late Prehistoric and historic times (e.g., the Apache, Comanche, and Tonkawa) supplanted these people. The old ways of life—practiced for many thousands of years by native groups—were long gone by the time most Euro-American observers came to central Texas.

As mentioned earlier in this chapter, understanding paleoenvironmental conditions and past habitats is a key to understanding Paluxy sites and how humans exploited their resources. Fort Hood is a transitional zone between the Edwards Plateau and the Blackland Prairies, but the environments of both regions have been altered seriously in historic times. Certainly the juniper forest and dense undergrowth seen across Fort Hood are an artificial environment developed through livestock overgrazing, intensive farming, and suppressing fires. All of these factors caused a loss of native vegetation and promoted the influx of many invader species. Several archeologists who worked at Fort Hood have recognized that the grassy landscape of the live fire area is significantly different from the juniper-choked habitat that characterizes the surrounding training areas. It is quite obvious that range fires that occur regularly within the live fire area at Fort Hood have helped restore this large area to its natural savannah and grassland habitats. In all probability, the live fire area is a good analog for how the Lampasas Cut Plain looked in late prehistory before Euro-American exploration and settlement. Thoms (1993:11) notes that "it is widely recognized that Indian people purposefully burned the prairies of the post oak savannah" in Texas (not far east of Fort Hood), and he speculates that the prehistoric people used fire to maintain open grassland habitats. The simple fact is that much of Texas was once a grassland savannah, but true grassland prairie habits are extremely scarce today.

Texas Parks and Wildlife Department (2003a) ecologists have rather succinctly sum-

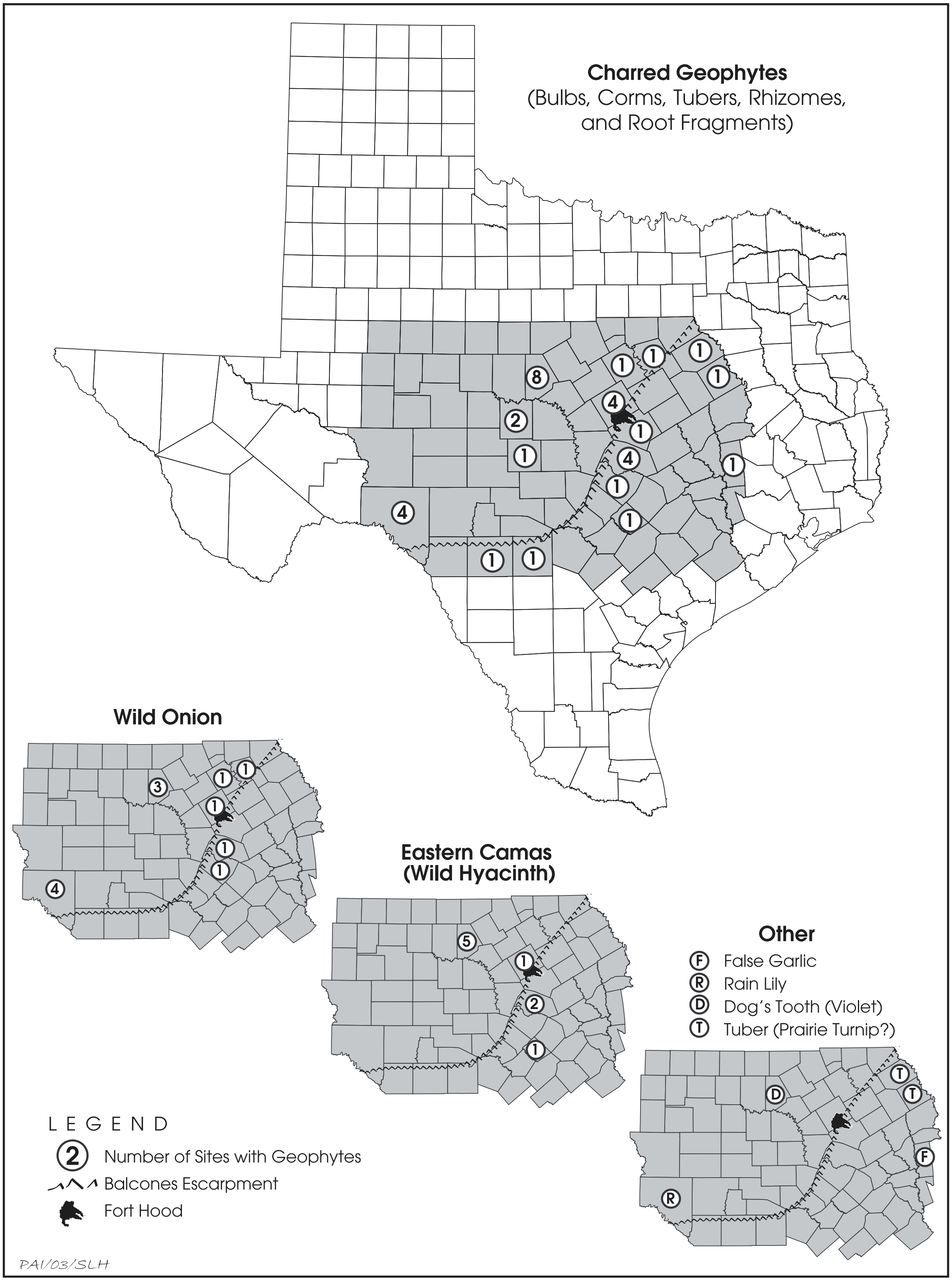

Figure 9.4. Geographic distribution of archeological occurrences of charred geophyte bulbs, corms, tubers, and root fragments in and around central Texas.

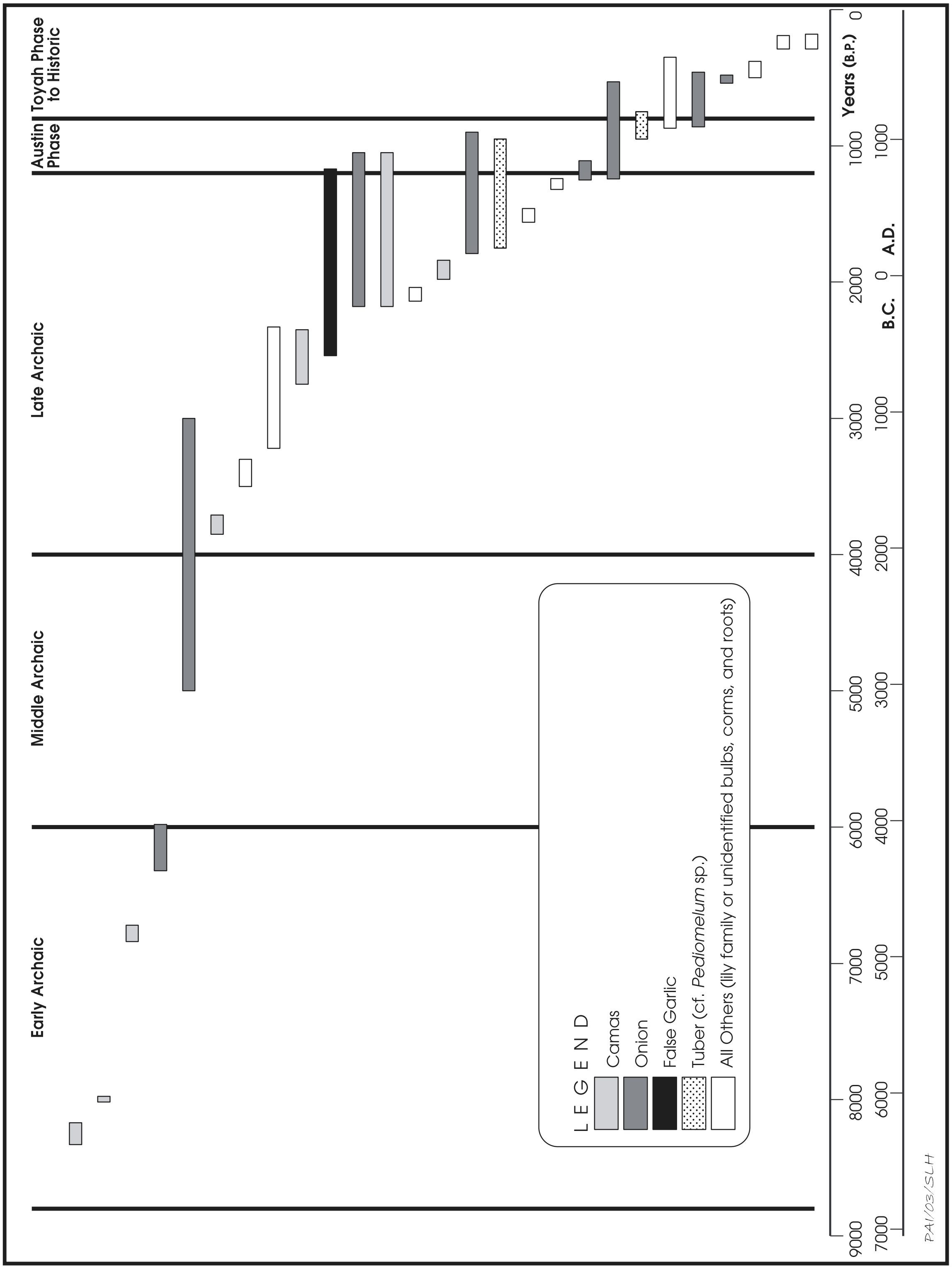

Figure 9.5. Temporal distribution of archeological occurrences of charred geophyte bulbs, corms, tubers, and root fragments in and around central Texas.

marized the historic changes to the environment and native vegetation of the Edwards Plateau. They state:

> When the Edwards Plateau region was settled by European man in the mid-1800s, it was maintained as a grassland savannah largely by grazing habits of bison and antelope as well as by frequent natural and man-made fires. The land supported a rich diversity of forbs and grasses. Cedar was restricted to over-grazed areas along rivers and streams, and in areas of shallow soils and steep canyons where fires did not occur frequently. White-tailed deer were rarely found in the grasslands. With European settlement came fences, cows, sheep, goats and the control of fire. Livestock were continuously grazed in fenced pastures which disrupted the natural movement patterns of grazing animals. Plants were not allowed to rest and recover from grazing. By 1900, continuous over-grazing and control of fire had taken its toll. The land began to change from a grassland to a brushland. Many of the woody brush species were readily grazed by sheep, goats, cattle, and an increasing deer herd. These animals have selective eating habits and eat the more desirable plants first and leave the less desirable plants for last. By the 1940's, many of the good quality plant species were highly depleted and not readily found on most ranges. The Edwards Plateau is now dominated by many poor quality browse, forb, and grass plants. Ashe juniper and red berry juniper (commonly called cedar) are highly undesirable forage plants for domestic livestock and deer. In much of the Edwards Plateau, cedar has become the dominant plant species causing a once diverse and healthy landscape to become a "cedar break" in many areas with very little plant diversity on the landscape.

For the Blackland Prairie region, Texas Parks and Wildlife Department (2003b) ecologists state that, "Although historically a region of tall-grass prairies, today much of the land is devoted to cropland and other agricultural enterprises . . . . Few remnant native prairie sites remain." The Native Prairie Association of Texas (2003) states that, "Today the Tall Grasses of the prairies are very rare. Tallgrass prairie in Texas is reduced by 99.99%. Losses are still occurring."

Among the victims of historical development in Texas are countless species of plants that make up a healthy native grassland in the Edwards Plateau and Blackland Prairie. Many species have disappeared completely, and the ranges of every species have been greatly altered. The modern distributions of eastern camas, wild onions, and other geophytes on Fort Hood no longer accurately represent their distributions in early historic or prehistoric times. Many of these plants are rare today but were probably common, if not abundant, in the past. Alston Thoms (personal communication, 1999) believes the historical record for *C. scilloides* is lacking in Texas because of the very early depletion of the indigenous population (Cheatham and Johnston 2000:518). Eastern camas populations are easy to destroy and slow to recover. Comparatively speaking, eastern camas is rare, but wild onions have faired much better and are more widely distributed in Texas. There are 15 species of *Allium* scattered over the entire state, and many are common in central Texas today (Cheatham and Johnston 1995:206). *Allium canadense* (several subspecies) and *Allium drummondi* are the two most common species over the eastern half of Texas (Cheatham and Johnston 1995:207–212).

In all likelihood, three factors more than any others caused the demise of many geophytes, most particularly eastern camas, in historic times. The first factor is cultivation, and Thoms (1989:145) notes that camas quickly dies out in regularly cultivated fields and hay meadows that are frequently cut because it never gets to produce seeds. Cultivated farms made up a significant portion of the Fort Hood lands during the late nineteenth and early twentieth centuries. In one year alone (1891–1892), for example, more than 45,000 acres in Coryell County and more than 100,000 acres in Bell County produced cotton, and cotton was a major cash crop for many decades.

The second factor, which goes hand–in–hand with the development of agriculture, is the suppression of wildfires. Wildfires are an important part of the ecology of a healthy grassland, and when Euro-Asmericans began to fight fires that would destroy their farms and homes, they unknowingly killed off the native prairies. The Native Prairies Association of Texas (2003b) maintains a list of "Central Texas Prairie Plants," and it includes wild onions and eastern camas, as well as other species of geophytes.

The third factor limiting the modern distributions of some geophyte species is hogs. It is widely known that hogs' love for eating bulbs virtually decimated the camas populations over large areas in the Pacific Northwest (Thoms 1989:143–144; Cheatham and Johnston 2000:528) and in Texas, where "camas is a magnet for feral hogs" (Cheatham and Johnston 2000:528). Dering (2003:119) notes that "…it is more likely that the distribution and abundance of eastern camas has been radically altered as a result of the introduction of Old World animals (wild hogs) and modern land use practices." Hogs almost certainly disturbed other plants in the lily family, too. Historic data on hogs compiled from Bell and Coryell County ad valorem tax records show that thousands of domestic hogs roamed the farms and ranches on Fort Hood lands between 1850 and 1915. The data on Fort Hood hog populations (compiled by Freeman et al. 2001:Appendix C) are extremely conservative because numbers were tabulated only for large herds of more than 10 hogs, and the data do not reflect the small numbers of hogs raised by almost every self-sufficient agricultural family. Nevertheless, the data show that large hog herds were widely distributed across the Fort Hood lands for many decades, especially between 1866 and 1892 (Freeman et al. 2001:36, Figure 15). The constant presence of even small numbers of free roaming hogs would have been detrimental to eastern camas and other geophyte plant populations. Farming and pigs probably took their toll on many plant species, and one can easily imagine that large patches of camas and wild onions once thrived in grassy meadows across most of the Fort Hood lands.

Any discussion of the role of plants as subsistence resources for prehistoric peoples in central Texas would be incomplete without some acknowledgment of the current status of archeobotanical studies. Studies of archeological geophytes are still in their infancy, and our overall knowledge of potential geophyte resources in the region is rudimentary. Although great strides have been made in archeobotany in recent years, there are limitations that must be overcome. Two significant and related problems are our inability to identify archeological plant specimens accurately and our limited knowledge of the vast range of potential geophyte resources that might have been exploited in prehistoric times. Ethnobotanists now can recognize only a few geophyte species when looking at small charred plant fragments, but there are many more potential food resources that have yet to be thoroughly examined. Phil Dering (personal communication 2003) and other ethnobotanists are well aware of this limitation and are striving to improve the situation. Although Dering has learned to recognize the structures of certain bulbs in the lily family, other plant root parts that have less distinctive cell structures may be very difficult to identify archeologically. Because of these concerns, it is almost certain that archeologists are looking at a very incomplete record of subsistence resources cooked in earth ovens.

One example—the case of prairie turnips—may help clarify the point that archeobotanical research is an evolving science. It has long been recognized that the geophytes classified in the genus *Pediomelum* sp, (formerly *Psoralia* sp.) were extremely important root foods for native peoples in historic times (Wedel 1986:17). Many of the common names attributed to these plants indicate how important their tubers were as subsistence resources: prairie turnip, Indian turnip, Indian breadroot, tallbread scurfpea, turnip root scurfpea, *pomme de prairie*, and prairie potato (e.g., Diggs 1999:683–687; Wedel 1986:). These plants are found all across the prairies of the Great Plains, and many species are found in Texas (Diggs 1999:683). Three species of *Pediomelum* have been found in botanical surveys on Fort Hood (Sanchez 2000), and one species—*Pediomelum rhombiolium*—was even found growing on the Paluxy sands in 1997 (see Kleinbach et al. 1999:Table 86). Despite knowing how important these tubers were for historic Indians, identifying small pieces of charcoal from prehistoric sites as being tubers is often difficult, and identifying them to the genus or species level is even harder. Charred tuber fragments have been found in prehistoric features in northern Texas, and they have been identified as *Pediomelum* sp. tubers in at least three cases.

Unfortunately, this literature is somewhat misleading. In the early 1980s, Gayle Fritz

(1987a, 1987b) identified tubers from prehistoric features at the Bird Point Island (Freestone County) and Adams Ranch (Navarro County) sites in north-central Texas. The tubers looked as though they could be *Psoralea* sp. (now *Pediomelum* sp.), but the botanical identifications were not absolute (Gayle Fritz, personal communication 2003). The specific identification of *Psoralea* sp. went into print as being absolutely positive (Bruseth and Martin 1987:45, 50, 51, 131, 244, 263). Also in the mid 1980s, charred tuber fragments from several Dallas County sites at Joe Pool Lake (Peter and McGregor 1988:50, 81, 166, 230, 332) were identified as being *Psoralea* sp., but these identifications also should be considered tentative. At Cooper Lake (Fields et al. 1993:Table 31) in northeast Texas, Phil Dering (1993) identified *Pediomelum* sp. tubers from four sites in Delta and Hopkins Counties, but he now considers this identification to be tentative and feels more work is needed before positive identifications to the genus level can be made with confidence (Phil Dering, personal communication 2003).

Based on these findings, there is now a general and widespread impression among Texas archeologists that prairie turnips (i.e., some species of *Pediomelum*) are well documented in prehistoric sites. It was all too easy to accept this assessment, but it appears to be premature. The simple fact is that many prehistoric sites have produced charred tubers that could be some species of *Pediomelum*, but these tubers could also belong to a number of other plant taxa that ethnobotanists working with archeological specimens have yet to study fully.

Paluxy Sites in the Forager-Collector Continuum

The Firebreak site may now be examined as it pertains to Binford's (1980) models of forager vs. collector strategies of resource use on the landscape, previously discussed in Chapter 3. It was noted that the Fort Hood area, which has a mean effective temperature of 15.3°C (59.5°F), is an environment in which people could have employed either foraging or collecting strategies rather effectively. The ultimate goal is to learn the overall subsistence strategy people used while they were living at the Firebreak site and at other Paluxy localities on Fort Hood.

Archeological evidence suggests that there was long-term continuity in resource exploitation at the Firebreak site from Late Archaic times through the Toyah phase. The radiocarbon ages and temporally diagnostic artifacts show that the occupations at Firebreak mirror those at many Paluxy sites (Figures 9.6 and 9.7). Previous investigations suggest that the Firebreak site is a fairly typical Paluxy site and a good representation of Paluxy sites in general. If this is true, then the same patterns of resource exploitation were repeated many times across the landscape of the western portion of Fort Hood over the last 3,000 years.

Based on chronological data from only five Paluxy sites, Abbott (1995c:822, Figure 9.15) had previously suggested that there was an "extended gap or low-use period" between 4000 and 2000 B.P. when Paluxy sites were not occupied. The more complete data (see Figure 9.6) now indicate that there were many Paluxy occupations between 3000 and 2000 B.P. and one occupation between 4000 and 3000 B.P. The apparent gap has virtually disappeared, and if there is a low-use period when occupations at Paluxy sites were infrequent, it is between 4000 and 3000 B.P. Thus, use of Paluxy sites and a similar pattern of resource exploitation may have remained constant over as many as 5,000 to 6,000 years.

Within Binford's (1980) model of hunter-gatherer adaptation, the Firebreak site seems to fit best in the forager system, although with limited comparative data, it is admittedly difficult to determine where a single site fits into the big picture. The Firebreak site appears to have functioned as a short-term residential campsite selected specifically because of its sandy soils and proximity to important resources. The key to understanding whether it was a residential base for foragers or collectors is to define the duration of occupation episodes (was it used for short or long periods?) and the degree of residential mobility (how often the group moved from base to base). Collectors had only a few main residential bases and would organize groups to go out and exploit bulk resources in patches at varying distances from the base. Foragers moved the whole group frequently from place to place, but each residential base was occupied for shorter periods while they foraged in the immediate area. Foraging and collecting are not mutually exclusive, and some groups operated as collectors for part of the year and as foragers for the rest of the year.

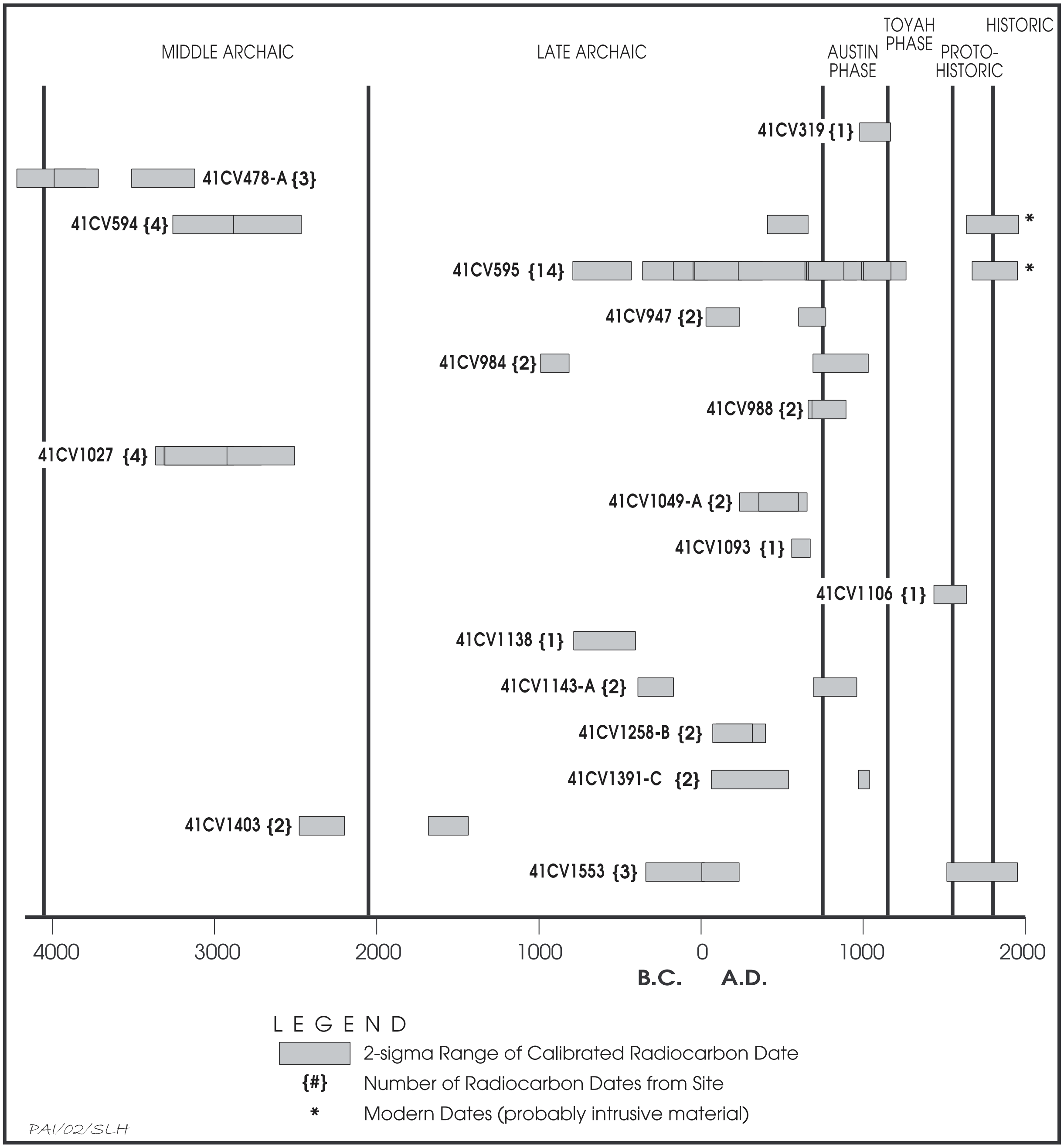

Figure 9.6. Chronology of Paluxy sites based on radiocarbon dates.

If our idea of biseasonal occupations is correct, then Firebreak was occupied primarily during the late spring-early summer spring bulb harvest and the fall acorn and nut harvest. The relatively low artifact density and general range of tool types, in conjunction with the broad range of radiocarbon dates and temporally diagnostic artifacts, suggest that repeated but short-term occupations occurred at Firebreak and that it functioned as a generalized residential base. Bettinger (1991:66) notes that because seasons of occupation and location of the resource varied little, the base camps should look alike. This appears to be true with Paluxy sites in general in that they have similar burned rock features, a scarcity of faunal remains, a plethora of floral remains, and a generalized stone technology. The near absence of cached artifacts and the lack of storage facilities at Paluxy sites also reflect a forager strategy. Only a few large metates left

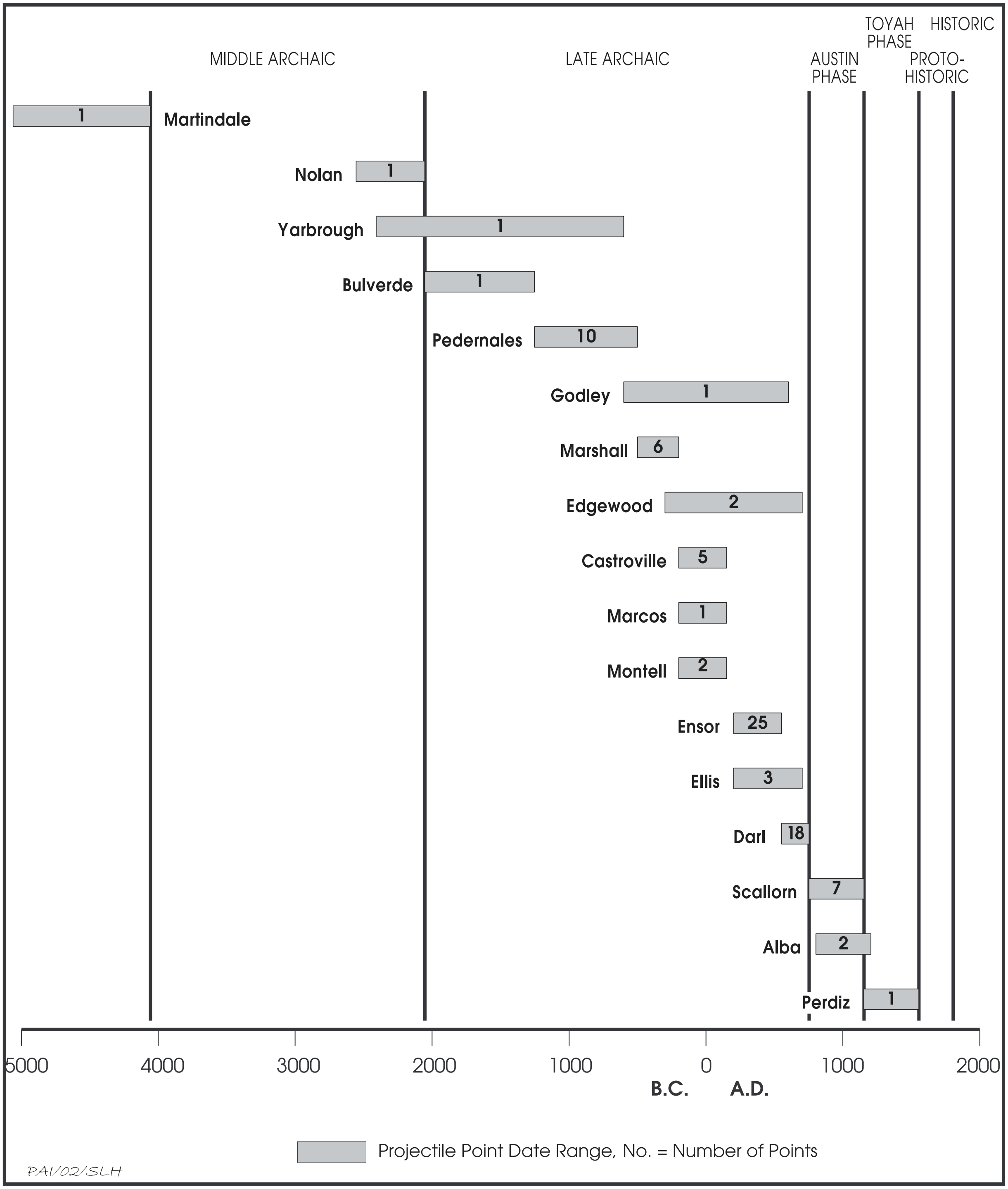

Figure 9.7. Chronology of Paluxy sites based on temporally diagnostic projectile points.

at these locales may represent curated items, and these tools were simply too large to be easily transported. To date, no storage facilities have been encountered on any site at Fort Hood. This does not mean they do not exist, but they were probably not necessary because of the overall abundance of food resources throughout the year.

During their stays, small bands (e.g., 25 to 50 people, including men, women, and older children) would have made daily trips to harvest resources within a specified foraging area (or resource catchment). If the foraging area encompassed a 5-kilometer-radius from the site, for example, it would take in almost all of the Stampede Creek drainage, a sizable chunk of Manning Mountain and its slopes, and a 7-km stretch of Cowhouse Creek. This area would include upland resources on the Manning and Killeen surfaces and riparian resources along Cowhouse and Stampede Creeks.

Although we have identified only four major plant resources used at Firebreak, many more resources undoubtedly were exploited. Regardless of the specific resources, individual occupations at Paluxy sites were probably short. If the people were looking for specific resources at particular times–wild onions and eastern camas for example–it would probably not take long for the group to harvest all the resources from many separate patches across the foraging area. Depending on how abundant any resource was, the group would probably spend anywhere from several days to a few weeks at a particular Paluxy site before depleting the sought-after resources. At that time, the group would probably move on to a new campsite from which they would harvest other patches. Using the late spring-early summer as an example, one can imagine that the short window of opportunity for harvesting onion and camas bulbs in any great quantity—probably on the order of four to six weeks—would require the group to change campsites several times to exploit those resources over a large area.

The contrasting idea—that Firebreak and other Paluxy sites were bases for specialized groups operating as collectors from major residential base camps—cannot be disproved, but the plant foods available in the spring and fall are well suited to exploitation by small groups using a generalized foraging strategy. One of the major advantages of foraging is high residential mobility. Binford (1983:204–208) argues that small hunter-gatherer groups are most effective when they range over a vast territory and constantly monitor the resources within it. In this sense, being very mobile provides security in having an intimate understanding of one's territory and the full range of resources available. Thus, a mobile foraging lifestyle is ideal for exploiting a wide range of plants and animals in a lush central Texas environment.

It is interesting that prehistoric peoples in central Texas never bothered with agriculture, but peoples all around them turned to farming in Late Prehistoric times (e.g., Caddoan peoples to the east, Plains Villagers to the north, and Jornado Mogollon peoples to the southwest). Binford (183:208) takes his argument a step further by suggesting that mobile hunter-gatherers have nothing to gain from becoming sedentary and dependent on a single staple resource. He thinks that loss of mobility was loss of security and that prehistoric peoples would take up something as radical as farming only if there were "something that prevented mobility as a security option." It seems entirely reasonable, then, to suggest that the central Texas environment was productive enough to support fairly large populations of hunter-gatherers throughout prehistory, and there was never any need for people to adopt more intensive subsistence strategies like farming. Collins (1995:387) observes that:

> Horticulture or agriculture had come to be practiced in all directions (Mesoamerica, the Southwest, Southeast, and Plains) during what in Central Texas was still the Late Archaic. Early European settlers found Central Texas optimal for farming . . ., and much of it is farmland today. A shift to horticulture or agriculture by natives of the region was not precluded by natural conditions of soil or climate. Nor was it precluded out of ignorance on the part of its inhabitants. These conclusions argue for the alternative interpretation that efficient technologies for hunting and gathering prevailed, and that the plant and animal resource base was both rich and diverse. Central Texas was one of those places in the world where the labors and limitations of food production could be looked upon with disdain.

Summary and Conclusions

Assuming that Paluxy sites were in fact short-term residential bases for foraging peoples, an annual cycle of movement and food resource exploitation may be proposed. What is suggested is not a comprehensive schedule of movements and subsistence activities in central Texas for any particular group at any particular time in prehistory. Rather, it is simply a rudimentary schedule that explains when and why people occupied outcrops of Paluxy sands. People came to camp on the Paluxy sand islands for short periods during the late spring or early summer when nearby meadows of camas and wild onion were prime for harvesting. After the spring rains when these plants went into their bloom cycles, they were easy to find, easy to dig, and their bulbs were at or near their maximum sizes. Large patches of wild onions and eastern camas would have been significant resources that would not have been overlooked. Many other geophyte plants were probably available, and people most likely harvested underground roots (i.e., bulbs, corms, rhizomes, taproots, and tubers) of plants that flowered during the spring and early summer.

Paluxy sites might have then been abandoned during the late summer, perhaps in favor of encampments along perennial streams or rockshelters near spring-fed drainages. During the hottest and driest part of the year, people would be attracted to the riparian areas along major streams where water, plants, and animals would be most concentrated, especially during drought years.

Throughout the fall, people would move their residential camps as often as necessary to exploit the most resources over a broad area. For short periods, people would return to Paluxy habitation sites to be close to oak groves to harvest and process the acorns. During the fall occupations at Paluxy sites, people may have made short foraging trips to harvest pecans that were abundant in nearby riparian areas (noting that virtually all of the Paluxy sites on Fort Hood are within 4 km of Cowhouse or House Creeks; see Figure 9.2) or acorns from nearby oak motts. Besides pecans and acorns, a wide range of fall-ripening nuts and berries were probably harvested during the fall by people living at Paluxy localities.

A biseasonal occupation at Paluxy sites is the most logical inference to be made from the archeological data now available, and it is the best explanation for the presence of charred bulbs of wild onion and eastern camas, as well as fragments of oak acorns and pecan shells, at the Firebreak site. Certainly the possibility that these foods were harvested elsewhere, stored, and brought to the site during other seasons must be considered. From this perspective, harvesting bulbs from Firebreak during the late spring-early summer flowering period–followed immediately by cooking and processing–makes perfect sense. In contrast, it makes less sense that people lived elsewhere while harvesting bulbs and that the uncooked bulbs were dried and stored elsewhere and then transported to Firebreak for cooking later. Not only would this be an inefficient use of labor, but the bulbs also would shrink and loose much of their mass and nutritional value. It is possible, of course, that the acorns and pecans were stored foods and could have been brought to Firebreak at any season of the year. It is more likely, however, that harvesting acorns and pecans was an important fall activity for people living at many different types of sites, including Paluxy sites.

People certainly may have operated as collectors while occupying other sites in the area at other times, but they were probably highly mobile during their brief stays at Paluxy localities. In this sense, a Paluxy residential base would be:

> "The hub of extractive activities, the place from which task groups depart to obtain food and raw materials and to which they subsequently return. It is also the place where most processing, manufacturing, and other activities of maintenance are done (Bettinger 1991:66).

As such, a Paluxy site served as the staging point for daily foraging excursions to harvest specific plant resources. The kind and location of the desired resource might vary daily as different plants came into play. People could also move quickly and easily from one Paluxy habitation to another to exploit one specific resource over a large area if the resource were available for only a short time. This type of foraging behavior exemplifies Binford's (1983:204–208) "mobility as a security option" philosophy quite well.

Based on his extensive ethnohistorical and archeological research on earth ovens, Richard Stark (personal communication 2002) suggests that although many of the resources cooked in earth ovens could be cooked in other ways, the earth ovens were used for bulk processing at crucial times. This observation appears to be valid over all of North America, from the Mescalero Apache of New Mexico to the Paiute of California and the Blackfeet in Canada (Wandsneider 1997:Appendix II). Wandsnider (1997) has demonstrated that there is a strong relationship between earth oven cooking technology and the types of plants being cooked. Specifically, she identifies a wide range of high-fructan root foods, all of which are geophytes, that had to be cooked for long periods, and large quantities of these plants were most efficiently processed in earth ovens. Many experiments by the authors and others (e.g., Black et al. 1998:168–175) have shown that the temperature inside an earth oven easily rises to or above the boiling point of water (100°C, 212°F) and can be maintained for long periods, often more than 48 hours. When moisture-bearing packing materials (such as prickly pear pads) are added, an earth oven becomes a steam oven and is extremely effective for breaking down the complex carbohydrates found in many geophytes (such as inulin and fructan) into simple sugars that can be easily digested (Dering 2003; Wandsneider 1997).

In all likelihood, prehistoric central Texas hunter-gatherers built their earth ovens very close to patches that produced large quantities of particular plant foods. Burned rock mounds and middens developed as those people returned to the same locations and used the same cooking features again and again.

Finds of prehistoric bulb fragments in central Texas are overwhelmingly associated with burned rock middens and earth ovens (see Table 8.18), indicating that geophytes were important plant foods that people integrated into their subsistence planning and annual cycle of activities. Geophytes were probably not the only important foods cooked in earth ovens, and it is very likely that many other plants were bulk processed in these cooking facilities.

But geophytes were extremely important to prehistoric peoples in central Texas, and they probably were harvested in large quantities during the short periods they were available. Such geophyte resources probably made up a significant portion of people's diets at certain times, and they may have even been dried and stored after being cooked. It also has been noted that bulk processing activities are often important ceremonial occasions for many peoples (Ellis 1997:46–50), although the social or ritual contexts of plant harvesting and processing among central Texas hunter-gatherers are poorly understood.

The connection between geophytes and the earth ovens, mounds, and middens where they were cooked is strong and long-standing in central Texas. Radiocarbon dates reveal that these earth oven plant-processing facilities were used for bulb processing during the Early Archaic period and from the Late Archaic into Protohistoric times. That geophyte bulbs have not been recovered from Middle Archaic components could be because sampling was inadequate or might represent some degree of cultural reality. During extended periods when climatic conditions were extremely dry, geophytic plants might have been rarer, people might have exploited them less often, and they would simply be less apt to appear in the archeological record. Because many burned rock middens across central Texas date to the Middle Archaic, however, it may simply be a matter of time before archeologists find more evidence that geophytes were being cooked then, too. It also is likely that many more types of root foods will be identified as more systematic flotation recovery and more exhaustive macrobotanical studies are undertaken.

The Paluxy sands on Fort Hood are only one type of location where prehistoric peoples processed geophytes using earth oven technology, and the link between geophytes and earth ovens goes far beyond the confines of Fort Hood or the geographic range of the Paluxy Formation. Thus, many of the conclusions offered here are not limited to the Paluxy environment and apply to all of greater central Texas. It is suggested that geophytes, including many different species in the Lily family, were more than simply flavorings being added to other foods. These plant root foods were superabundant for short periods and were extremely important resources for prehistoric central Texas hunter-gatherers during those brief occasions. They were intensively exploited by mobile foraging groups, and the need for long-term heating of these foods meant that the most efficient way to process large quantities was in earth ovens. Repeated use of earth ovens in a single place over time turned many processing locations into burned rock mounds and middens. The use of geophytes and the associated cooking technology have remained fundamentally unchanged for at least 8,500 years.

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APPENDIX A: Soil Stratigraphic Profiles

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Site 41CV595

Backhoe Trench 6, south wall

Zone 1 0–20 cm	Interbedded light yellowish brown (10YR 6/4, moist) silty clay loam and very dark grayish brown (10YR 3/2, moist) very fine sandy loam, 10 percent limestone gravels (angular to sub-angular, granule- to pebble-sized), abrupt wavy lower boundary. Recent colluvium and slopewash, Cu horizon.
Zone 2 20–38 cm	Dark grayish brown (10YR 4/2, moist) to very dark grayish brown (10YR 3/2, moist), friable, fine sandy loam, moderate medium blocky angular structure, 5 percent limestone and sandstone gravels (angular to subangular, granule-sized), few pieces of dispersed charcoal, gradual smooth lower boundary. Late Holocene colluvium and slopewash, A horizon.
Zone 3 38–106+ cm	Dark grayish brown (10YR 4/2, moist), friable, fine sandy loam, weak fine blocky angular structure, 5–10 percent limestone and sandstone gravels (angular to subangular, granule-sized), lower boundary not observed. Late Holocene colluvium and slopewash, Bc horizon.

Backhoe Trench 7, north wall (Test Unit 60)

Zone 1 0–69+ cm	Black (10YR 2/1, moist), friable, silt loam, weak fine blocky subangular structure, many (> 50 percent) burned rocks (subangular, cobble-sized), lower boundary not observed. Anthropogenic deposit and late Holocene colluvium and slopewash, A horizon.

Backhoe Trench 7, south wall (Test Unit 62)

Zone 1 0–27 cm	Very dark grayish brown (10YR 3/2, moist), friable, fine sandy loam, weakfine blocky angular structure, common prominent coarse mottles (10YR 4/3), clear smooth lower boundary. Late Holocene colluvium and slopewash, A/E horizon.
Zone 2 27–57 cm	Brown (7.5YR 4/4, moist), firm, sandy clay loam, strong coarse blocky angular structure, common krotovinas, abrupt broken lower boundary. Late Pleistocene to early Holocene colluvium and slopewash, 2Bt horizon.
Zone 3 57+ cm	White caliche, lower boundary not observed. K horizon.

Backhoe Trench 8, north wall

Zone 1 0–22 cm	Dark grayish brown (10YR 4/2, moist), fine sandy loam, friable, moderate medium blocky angular structure, common distinct medium mottles (10YR 5/4), clear smooth lower boundary. Late Holocene colluvium and slopewash, A horizon.
Zone 2 22–43 cm	Brown (10YR 4/3, moist), fine sandy loam, friable, weak fine blocky angular structure, common distinct medium (10YR 5/4), 5 percent slimestone and sandstone gravels (angular to subangular,

	granule-sized), few $CaCO_3$ filaments, clear smooth lower boundary. Late Holocene colluvium and slopewash, Bw horizon.
Zone 3 43–82 cm	Light yellowish brown (10YR 6/4, moist), loamy fine sand, friable, weak fine blocky angular structure, 20percent sandstone fragments, abrupt wavy to broken lower boundary. Lower Cretaceous Paluxy Formation, 2C horizon.
Zone 4 82+ cm	Sandstone bedrock. Lower Cretaceous Paluxy Formation, R horizon.

Gradall Trench 1, east wall

Zone 1 0–30 cm	Brown (10YR 4/3, moist), very fine sandy loam, friable, moderate fine blocky angular structure, common burned rocks, few pieces of charcoal, clear wavy lower boundary. Late Holocene colluvium and slopewash, A horizon.
Zone 2 30–76 cm	Strong brown (7.5YR 5/6, moist), sandy clay loam, firm, strong medium blocky angular structure, clear smooth lower boundary. Late Pleistocene and early Holocene colluvium and slopewash, 2Bt horizon.
Zone 3 76–132+ cm	Strong brown (7.5YR 5/6, moist), sandy clay, firm, moderate medium blocky angular structure, common $CaCO_3$ filaments, common highly weathered and rounded sandstone fragments, lower boundary not observed. Lower Cretaceous Paluxy Formation, 2Bk horizon.

Site 41CV988

Gradall Trench 1, south wall

Zone 1 0–32 cm	Brown (10YR 4/3, moist), very fine sandy loam, friable, moderate coarse blocky angular structure, many distinct coarse mottles (10YR 5/4), <2 percent limestone gravels (subangular, granule- to pebble-sized), clear smooth lower boundary. Late Holocene colluvium and slopewash, A horizon.
Zone 2 32–91 cm	Yellowish brown (10YR 5/4, moist), silt loam, very friable, moderate coarse blocky angular struc-ture, common fine $CaCO_3$ filaments, abrupt smooth lower boundary. Late Holocene colluvium and slopewash, Bk horizon.
Zone 3 91–103 cm	Yellowish brown (10YR 5/4, moist), very fine sandy clay loam, very friable, moderate medium blocky angular parting to fine blocky angular structure, many fine $CaCO_3$ filaments, common sandstone fragments, abrupt smooth lower boundary. Lower Cretaceous Paluxy Formation, 2Btk horizon.
Zone 4 103–113+ cm	Yellowish brown (10YR 5/4, moist), very fine sandy clay loam, very friable, moderate medium blocky angular structure, common

sandstone fragments, common fine $CaCO_3$ filaments, lower boundary not observed. Lower Cretaceous Paluxy Formation, 2Btk2 horizon.

Test Unit 13, east wall

Zone 1 0–24 cm	Very dark grayish brown (10YR 3/2, moist), very fine sandy loam, very friable, weak coarse blocky angu-lar structure, abrupt smooth lower boundary. Late Holocene colluvium and slopewash, A horizon.
Zone 2 24–45+ cm	Yellowish red (5YR 4/6, moist), fine sandy clay, firm, moderate coarse prismatic parting to medium blocky angular structure, common distinct fine mottles (5YR 4/4), few fine clay films on ped faces, few pores, lower boundary not observed. Late Pleistocene and early Holocene colluvium and slopewash, 2Bt horizon.

Site 41CV1141

Backhoe Trench 6, east wall

Zone 1 0–32 cm	Very dark gray (10YR 3/1, moist), very fine sandy loam, friable, weak medium blocky subangular structure, common burned rocks, clear wavy lower boundary. Anthropogenic deposit and late Holocene colluvium and slopewash, A horizon.
Zone 2 32–58 cm	Dark brown (7.5YR 3/3, moist), sandy clay loam, very friable, moderate fine blocky subangular structure, common distinct fine mottles (7.5YR 5/6), few pieces of charcoal, abrupt wavy lower boundary. Late Holocene colluvium and slopewash, Bw horizon.
Zone 3 58–72+ cm	Dark reddish brown (5YR 3/4, moist), silty clay, very firm, moderate medium blocky angular structure, common distinct clay films on ped faces, few fine $CaCO_3$ filaments, lower boundary not observed. Late Pleistocene and early Holocene colluvium and slopewash, 2Bt horizon.

Backhoe Trench 11, east wall

Zone 1 0–26and 59 cm[1]	Very dark brown (10YR 22, moist), very fine sandy loam, firm, moderate coarse blocky angular structure, many burned rocks, abrupt wavy lower boundary. Anthropogenic deposit and late Holocene colluvium and slopewash, A horizon.
Zone 2 26–38+ cm and 59–68+ cm	Dark brown (7.5YR 3/4, moist), sandy clay loam, very firm, strong coarse blocky angular structure, lower boundary not observed. Late Pleistocene and early Holocene colluvium and slopewash, 2Bt horizon.

[1] Because zone depths vary within the trench, minimum and maximum depths are given.

APPENDIX B: Analysis of Macrobotanical Remains from Three Paluxy Sites on Fort Hood, Texas

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Prewitt and Associates, Inc., submitted 12 carbon and 75 flotation samples recovered from 8 features for botanical analysis. This appendix presents a description of the plant materials from these sites—41CV595, 41CV988, and 41CV1141. The archeobotanical assemblage from these sites will be interpreted and compared to other sites across central Texas. Included in this data are identifications of wood, acorn and nut fragments, and bulb fragments.

METHODS

The analysis follows standard archeobotanical laboratory procedures. Each flotation sample is passed through a nested set of screens of 4-mm, 2-mm, and 0.450-mm mesh and examined for charred materials, which are separated for identification. Because of the high rates of deterioration at most open archaeological sites in North America, including those found in arid regions, only carbonized plant materials are considered part of the archeological record. Charred wood caught on the 4-mm and 2-mm mesh screens is separated for weighing, counting, and identification. Carbonized wood from the 4-mm and 2-mm screens (smaller pieces are seldom identifiable) were separated in a grab sample and identified.

Material from all of the sieve levels, including the bottom pan, was scanned for floral parts, fruits, and seeds. Carbonized wood was identified using the snap technique, examining them at 8–45X magnifications with a hand lens or a binocular dissecting microscope, and comparing them to reference specimens in the archeobotanical herbarium.

Some woods are so similar anatomically that it is very difficult to identify them to the genus level. In other cases, genera within a plant family are usually distinguishable, but archaeological material may be too fragmented or deteriorated to allow identification to the genus level. For these reasons, some taxa are combined into wood types. All identifications in these categories represent identifications to the taxon level indicated by type name. The following wood types or categories are used in this report:

Willow and Cottonwood Wood Type (Salicaceae)—Includes members of the Salicaceae, willow and cottonwood, which are difficult to distinguish.

Rose Family Wood Type (Rosaceae)—Includes hawthorns, wild plums, and wild peaches. Small charred fragments of these woods are difficult to distinguish.

Indeterminate Hardwood—Refers to any woody seed-bearing plant—that is, not a cone-bearing tree such as pine, cypress, or juniper.

Bulbs are specific types of underground plant organs that store relatively large amounts of energy to allow a plant to overwinter or aestivate during times when environmental conditions are not conducive to growth. They serve as a storehouse of energy for initial growth during the early stages of a growing season. As such, bulbs provide an excellent carbohydrate source for humans.

Although they grow underground, bulbs are not roots but rather are modified leaves arranged in a rosette around a compressed, central stem. The modified leaves of a bulb are termed bulb scales. Because they are leaves, the epidermal cells (outer skin) of bulb scales have distinctive shapes that are duplicated within a species and are often unique to that species. This epidermal pattern provides virtually the only clue for identifying the genus or species of the plant because the overall shape of any bulb is so modified during cooking or when charred.

Bulb fragments are identified by scanning electron microscopy of the epidermal patterns observed on the dorsal surface of the leaf scale. Leaf scale fragments were attached to aluminum stubs using 12-mm-diameter carbon conductive adhesive tabs. After the samples were dried for 24 hours in a desiccator, they were pretreated by evacuating a vacuum chamber to 60 millitor and coating the target with gold-palladium for 8 minutes. A thick coating produced the best results. The samples were photographed using Polapan 400 film at low magnification (100–350X). Identifications were established by comparing samples to a reference collection of bulb scale photographs at Texas A&M University.

Each bulb scale consists of at least three tissue types arranged in layers—the upper epidermis and its cuticular covering, the lower epidermis and its cuticular covering, and the palisade parenchyma, sandwiched in between the two epidermal layers. The middle parenchyma layer usually contains abundant starch grains that must be distinguished from the epidermal material. Images of the upper epidermis are best for comparing to reference materials because the cell patterns in the upper epidermis appear to be most useful in identifying the taxon of the bulb.

Charring often makes it difficult to distinguish between the cells in the parenchyma and the cells in the epidermis at low magnification, which complicates selection of the material that is attached to the aluminum stubs. Using the high resolution of the scanning electron microscope images, it is very easy to distinguish the epidermal tissue. To determine this, however, it is usually necessary to conduct several scans of each bulb fragment before a good image of the epidermal surface of a bulb fragment is secured.

RESULTS

Twelve separate carbon samples were submitted for identification before they were sent for radiocarbon dating (Table B.1). The samples came from two sites (41CV595 and 41CV1141) and were identified as charred oak wood and camas bulbs. Nine of the samples were dated (see Table 7.6)

Charred nutshell fragments (pericarp), bulb fragments, and wood were identified in the 75 flotation samples (Table B.2), and they yielded 21 different plant taxa or wood types. Of the 54 samples analyzed from 41CV595, 33 yielded identifiable plant remains. Several samples from 41CV595, especially those from Features 7 and 15, yielded abundant charred plant material. Of the 4 samples examined from 41CV988, 1 yielded identifiable plant remains, and of the 17 samples from 41CV1141, 6 contained identifiable plant remains.

41CV595

This site consisted of a series of fire-cracked rock concentrations, rock-lined earth ovens, and related features. Thirteen features were sampled by flotation (Table B.3). Of these, 4 contained identifiable evidence of edible plant remains. Most of the charred plant remains (97 percent by weight) were recovered from the excavations in Area 2. Features 7 and 15 contained remarkably well-preserved plant food remains in the form of charred bulbs. Features 8 and 11 contained possible evidence of acorn processing in the form of 28 charred acorn fragments. A brief discussion of the plant remains recovered from each feature is presented below.

Feature 3

The botanical assemblage from this feature was limited. Oak, box elder, and willow were noted in the samples. Of the 17 samples examined from this feature, 11 did not contain identifiable carbonized plant remains.

Table B.1. Carbon samples for macroplant identification and radiocarbon dating

Site	Field Sample No.	Grams	Provenience (elevation in meters)	Identification	Comments
41CV595	C-17	0.4	Test Unit 16, 99.48	*Quercus* sp wood.	–
41CV595	C-28	0.9	Feature 8, Test Unit 33, 99.34	*Quercus* sp. wood	–
41CV595	C-30	0.3	Feature 11, Test Unit 34, 99.16	*Quercus* sp. wood	–
41CV595	C-35	0.6	Feature 11, Test Unit 35, 99.07	*Quercus* sp. wood	–
41CV595	C-39	0.8	Feature 14, Test Unit 52, 99.42	*Quercus* sp. wood	–
41CV595	C-40	2.5	Feature 11, Test Unit 35, 99.00	*Quercus* sp. wood	–
41CV595	C-44	0.1	Feature 15, Test Unit 50, 98.89	*Camassia scilloides* bulb fragment	–
41CV595	C-45	3.6	Feature 15, Test Unit 43, 99.04–98.99	Indeterminate porous hardwood	–
41CV595	F-6	0.2	Feature 3, Test Unit 64, 95.90–95.80	Uncharred root (modern)	Not dated
41CV595	C-38	13.6	Feature 7, Test Unit 42, 99.05	*Quercus* sp. wood	Not dated
41CV595	C-42	0.2	Feature 15, Test Unit 50, 98.97	*Camassia scilloides* bulb fragment	Not dated
41CV1141	C-2	0.9	Feature 6, Test Unit 6, 96.00	*Quercus* sp. wood	–

Table B.2. Plant taxa identified in the samples

Taxon	Common Name	Plant Part
Acer sp.	maple	wood
Acer negundo	boxelder	wood
cf. *Allium canadense*	onion	bulb
cf. *Camassia scilloides*	eastern camas	bulb
Carya illinoiensis	pecan	wood, nutshell
Celtis sp.	hackberry	wood
Cornus drummondii	dogwood	wood
Diospyros sp.	persimmon	wood
Fraxinus sp.	ash	wood
Indeterminate Hardwood	–	wood
Juglans sp.	walnut	wood
Morus sp.	mulberry	wood
Quercus sp.	oak	wood, shell or pericarp
Rhus sp.	sumac	wood
Robinia pseudo-acacia	black locust	wood
Rosaceae	rose family wood type	wood
Salicaceae	willow family wood type	wood
Salix sp.	willow	wood
Sapindus saponaria	soapberry	wood
Ulmaceae	elm family	wood
Ulmus sp.	elm, cf. American elm	wood

Features 4, 5, and 6

Six flotation samples were examined from these small features, but only Features 4 and 5 yielded charred plant remains. Oak, pecan, and rose family (possibly hawthorn) wood were the taxa identified in the samples. As in Feature 3, plant materials were very sparse.

Feature 7

The primary cultural zone throughout the Area 2 excavation block contained a consistent scatter of burned rocks designated Feature 7. The eight flotation samples analyzed from this sample yielded considerable plant material (190 fragments; 30.9 g). Feature 7 probably represents clean-out episodes from Feature 15, a formally constructed earth oven, and other earth ovens nearby that were not excavated. The diverse array of plant taxa noted in these feature samples probably reflects remains from many pit-baking episodes. Oak, sumac, ash, hackberry, elm, dogwood, box elder, walnut, and rose family wood fragments were noted in these samples. Two samples also contained a total of 31 bulb fragments. These most likely represent two genera, *Allium* (onion) and *Camassia* (camas). This is the first time that two different bulb taxa have been identified from the same site.

Features 8 and 11

These features both contained acorn fragments. Although there were not many acorn fragments, they deserve mention because acorns are an ethnographically documented source of carbohydrates. They are produced in bulk and have the potential to contribute a large portion of the calories in a person's diet, at least seasonally.

But most of the techniques used to process acorns, as described in ethnographic literature (Jackson 1991), would not generally result in accidental charring of the acorns. This limits the possibility for recovering acorn fragments and our ability to detect acorn processing in the archeological record.

Further, acorns may be introduced into a fire pit along with the fuel load, making it more difficult to recognize acorn processing in the archeobotanical record. These features, therefore, may have been related to acorn processing, but it is not possible to interpret them absolutely as such.

Table B.3. Summary of plant remains, 41CV595, by area and feature

Context	Test Unit	Flotation Sample No.	Volume (liters)	Taxon	Common Name	Plant Part	Count	Weight (g)
Area 1								
Feature 6	7	19	2.25	no carbonized plant remains	n/a	–	–	–
	6	20	4.00	*Quercus* sp.	oak	wood	7	0.2
				Rosaceae	rose family	wood	4	0.1
Area 1 Subtotal			6.25				11	0.3
Area 2								
Feature 7 (general burned rock scatter)	43	21	2.25	*Quercus* sp.	oak	wood	12	2.1
				Rhus trilobata	sumac	wood	7	0.3
				Sapindus saponaria	soapberry	wood	6	0.4
	49	22	4.50	*Celtis* sp.	hackberry	wood	5	0.3
				Fraxinus sp.	ash	wood	10	1.4
				Juglans sp.	walnut	wood	5	0.3
				Quercus sp.	oak	wood	5	0.5
	46	31	2.00	*Fraxinus* sp.	ash	wood	5	0.1
				Quercus sp.	oak	wood	4	0.1
	38	32	3.75	no carbonized plant remains	n/a	–	–	–
	42	42	2.00	*Allium canadense*	wild onion	bulb fragment	4	0.4
				Celtis sp.	hackberry	wood	5	1.4
				Quercus sp.	oak	wood	20	6.7
	42/43	43	2.25	*Camassia scilloides*	eastern camas	bulb fragment	27	3.9
				Quercus sp.	oak	wood	21	5.3
				Ulmus sp.	elm	wood	4	0.4
	50	51	10.50	*Cornus drummondii*	dogwood	wood	6	0.7
				Quercus sp.	oak	wood	14	2.9
				Rosaceae	rose family	wood	5	0.3
	36/43	52	6.25	*Acer negundo*	boxelder	wood	2	0.2
				Celtis sp.	hackberry	wood	7	0.5
				Juglans sp.	walnut	wood	3	0.2
				Quercus sp.	oak	wood	13	2.5
Subtotal			33.50				190	30.9
Feature 8	27	35	54.00	*Carya* sp.	hickory	wood	5	0.3
				no carbonized plant remains	n/a	–	–	–
				Platanus sp.	sycamore	wood	2	0.1
				Quercus sp.	oak	acorn shell	3	0.1
				Quercus sp.	oak	wood	14	1.2
				Ulmus sp.	elm	wood	6	0.2
	28	36	12.75	*Fraxinus* sp.	ash	wood	5	0.3
				Juglans sp.	walnut	wood	7	0.4
				Quercus sp.	oak	wood	10	3.1

Table B.3, continued

Context	Test Unit	Flotation Sample No.	Volume (liters)	Taxon	Common Name	Plant Part	Count	Weight (g)
				Quercus sp.	oak	acorn shell	7	0.1
				Rhus sp.	sumac	wood	3	0.4
	33	37	15.75	*Fraxinus* sp.	ash	wood	5	0.3
				Quercus sp.	oak	acorn shell	4	0.1
				Quercus sp.	oak	wood	21	4.3
Subtotal			82.50				92	10.9
Feature 10	32	30	1.50	no carbonized plant remains	n/a	–	–	–
Subtotal			1.50				0	0.0
Feature 11	34	38	7.00	*Carya illinoiensis*	pecan	nut shell	2	0.1
				Morus sp.	mulberry	wood	5	0.7
				Quercus sp.	oak	wood	17	3.7
	35	39	27.50	*Carya illinoiensis*	pecan	wood	5	0.4
				Quercus sp.	oak	wood	14	2.1
				Quercus sp.	oak	acorn shell	6	0.1
				Salicaceae Type	willow Family	wood	6	0.4
	31	40	15.50	*Quercus* sp.	oak	wood	17	1.1
				Quercus sp.	oak	acorn shell	8	0.1
				Salicaceae Type	willow Family	wood	8	0.4
	36	45	22.50	*Celtis* sp.	hackberry	wood	3	0.2
				Juglans sp.	walnut	wood	8	0.5
				Quercus sp.	oak	wood	15	2.0
Subtotal			72.50				114	11.8
Below Feature 11	31/35	41	13.00	*Diospyros* sp.	persimmon	wood	4	0.5
				indeterminate	n/a	wood	1	0.2
				Quercus sp.	oak	wood	17	2.1
Subtotal			13.00				22	2.8
Feature 12	29	33	3.00	*Acer* sp.	maple	wood	5	0.1
				Fraxinus sp.	ash	wood	4	0.1
				Quercus sp.	oak	wood	6	0.1
Subtotal			3.00				15	0.3
Feature 13	22	34	2.75	no carbonized plant remains	n/a	–	–	–
Subtotal			2.75				0	0.0
Feature 14	52	44	1.25	indeterminate	n/a	wood	5	0.1
				Quercus sp.	oak	wood	16	4.8
				Ulmus sp.	elm	wood	4	2.4
Subtotal			1.25				25	7.3

Table B.3, continued

Context	Test Unit	Flotation Sample No.	Volume (liters)	Taxon	Common Name	Plant Part	Count	Weight (g)
Feature 15	42	47	7.50	*Quercus* sp.	oak	wood	25	1.7
	50	48	9.00	*Camassia scilloides*	eastern camas	bulb fragment	5	0.3
				Carya illinoiensis	pecan	wood	15	2.3
				indeterminate	n/a	wood	4	0.1
				Quercus sp.	oak	wood	10	0.4
	50	49	16.00	*Camassia scilloides*	eastern camas	bulb fragment	35	1.3
				Cornus drummondii	dogwood	wood	7	0.3
				indeterminate	n/a	wood	4	0.1
				Morus sp.	mulberry	wood	1	0.1
				Quercus sp.	oak	wood	12	2.3
				Rosaceae	rose family	wood	2	0.1
	43	50	9.00	*Camassia scilloides*	eastern camas	bulb fragment	1	0.7
				Quercus sp.	oak	wood	20	6.9
				Ulmus sp.	elm	wood	5	1.3
	43	53	3.75	indeterminate	n/a	wood	4	0.2
				Quercus sp.	oak	wood	20	3.9
				Sapindus saponaria	soapberry	wood	4	0.2
Subtotal			45.25				174	22.2
Below Feature 15	43	54	4.75	*Camassia scilloides*	eastern camas	bulb fragment	1	0.3
				Celtis sp.	hackberry	wood	2	0.1
				indeterminate	n/a	–	4	0.1
				Quercus sp.	oak	wood	19	2.7
Subtotal			4.75				26	3.2
Adjacent to Feature 8	20	29	1.75	*Celtis* sp.	hackberry	wood	7	0.2
				Fraxinus sp.	ash	wood	5	0.3
				indeterminate Hardwood	hardwood	wood	4	0.2
				Quercus sp.	oak	wood	9	0.3
Modern soil stain	51	46	2.50	indeterminate	–	wood	5	0.1
				Quercus sp.	oak	wood	10	0.3
Subtotal			4.25				40	1.4
Area 2 Subtotal			266.00				698	90.8
Area 3								
Feature 3	64	1	4.50	*Acer* sp.	boxelder	wood	9	0.2
				Hardwood Type		wood	3	0.1
				Quercus sp.	oak	wood	13	0.4
	63	2	4.50	*Quercus* sp.	oak	wood	7	0.1
				Salix sp.	willow	wood	4	0.2
	64	3	4.50	*Quercus* sp.	oak	wood	6	0.2
	63	4	4.25	indeterminate	–	wood	5	0.2

Table B.3, continued

Context	Test Unit	Flotation Sample No.	Volume (liters)	Taxon	Common Name	Plant Part	Count	Weight (g)
	63	5	4.25	no carbonized plant remains	n/a	–	–	–
	64	6	4.00	*Quercus sp.*	oak	wood	3	0.1
	57	7	5.00	no carbonized plant remains	n/a	–	–	–
	63	8	4.50	no carbonized plant remains	n/a	–	–	–
	57	10	4.00	no carbonized plant remains	n/a	–	–	–
	63	11	4.75	*Quercus* sp.	oak	wood	5	0.1
	57	12	3.50	no carbonized plant remains	n/a	–	–	–
	65	15	4.25	no carbonized plant remains	n/a	–	–	–
	65	17	4.25	no carbonized plant remains	n/a	–	–	–
	65	18	2.50	no carbonized plant remains	n/a	–	–	–
	58	23	2.25	no carbonized plant remains	n/a	–	–	–
	58	24	6.75	no carbonized plant remains	n/a	–	–	–
	67	25	2.25	no carbonized plant remains	n/a	–	–	–
Subtotal			70.00				55	1.6
Feature 4	64	9	9.50	*Quercus* sp.	oak	wood	4	0.1
	64/65	28	43.25	*Carya illinoiensis*	pecan	wood	6	0.3
				Quercus sp.	oak	wood	3	0.1
Subtotal			52.75				13	0.5
Feature 5	62	14	2.25	no carbonized plant remains	n/a	–	–	–
	62	16	2.25	no carbonized plant remains	n/a	–	–	–
Subtotal			4.50				0	0.0
Feature 9	66	27	1.75	no carbonized plant remains	n/a	–	–	–
Subtotal			1.75				0	0.0
Nonfeature	57	13	4.25	no carbonized plant remains	n/a	–	–	–
	68	26	4.50	no carbonized plant remains	n/a	–	–	–
Subtotal			8.75				0	0.0
Area 3 Subtotal			136.00				68	2.1
Total			408.25				777	93.2

Note: Acorn and pecan shell are pericarp fragments.

Features 9, 10, 12, and 14

Very little material was recovered from these features. Features 9 and 10 contained no material whatsoever. Features 12 and 14 contained oak, elm, ash, and maple wood.

Feature 15

This feature contained abundant charred wood remains and bulb fragments (174 fragments; 22.2 g). Wood types identified in the feature include oak, pecan, dogwood, soapberry, mulberry, elm, and rose family. By far the most abundant wood type is oak.

A total of 42 bulb fragments, some very large, were recovered from this big, rock-lined feature interpreted as an earth oven. Most of the bulb fragments have been tentatively identified as eastern camas, although not all the materials were examined using scanning electron microscopy. Interestingly, no acorn or nut fragments were noted in the samples from this feature.

A single sample taken from below Feature 15 contained one fairly large camas bulb fragment. These materials are probably associated with Feature 15 and were transported downward by bioturbation of the sandy sediments.

A point-provenienced charcoal sample was submitted for identification before being sent for radiocarbon dating. The sample, from Feature 15 (98.89 elevation, Test Unit 50) was identified as a fragment of a *camassia scilloides* bulb. It later was sent for radiocarbon assay and yielded a calibrated (2-sigma range) date of A.D. 60–940 (see Table B.1).

41CV988

Of four flotation samples examined from 41CV988, only one yielded any charred plant remains (Table B.4). A single fragment of oak wood was identified.

41CV1141

Of the 17 flotation samples examined from 41CV1141, 8 yielded no carbonized remains (Table B.5). Charred wood fragments representing four different taxa—oak, hackberry, elm, and rose family—were recovered from three different features. Five oak acorns also were recovered from two different features.

DISCUSSION

Before the studies of burned rock middens conducted in the early 1990s, the identity of plant food resources recovered in earth oven contexts was virtually unknown. Pioneering studies such as those by Darrell Creel (1986) could not conduct extensive flotation analysis, and it is doubtful that plant root foods would have been identified at that time because analysts were unable to recognize them. In 1988, a list of botanical remains compiled for a symposium on burned rock midden archeology included only seeds (Howard 1991:65). Although bulb fragments had been noted in dry deposits of rockshelters from the Lower Pecos region for decades (Dering 1975) and a cache of charred bulbs was recovered from Horn Shelter in the 1970s (Watt 1978), analysts overlooked or did not recognize them in flotation samples from open sites until the early 1990s (Dering 1997).

The eventual recognition of bulbs in flotation samples from open sites is attributable to two factors. First, flotation recovery and analysis of botanical samples were finally emphasized in Texas during the 1990s. More significantly, identification was aided by discovery and analysis of several complete charred bulbs point-collected from the Wilson-Leonard site. Most of the bulbs were intact, allowing identification of at least the general plant structure. At the normal magnifications under which macrobotanical work is conducted (8–75X), it is almost

Table B.4. Summary of plant remains, 41CV988

Flotation Sample No.	Name	Common	Part	Count	Weight (g)
1	no carbonized plant remains	NA	NA	–	–
2	no carbonized plant remains	NA	NA	–	–
3	no carbonized plant remains	NA	NA	–	–
4	*Quercus* sp.	oak	wood	1	0.1

Table B.5. Summary of plant remains, 41CV1141, by context

Context	Flotation Sample No.	Taxon	Common Name	Plant Part	Count	Weight (g)
Feature 1	3	*Quercus* sp.	oak	acorn	3	0.1
		Quercus sp.	oak	wood	14	0.4
	7	*Quercus* sp.	oak	wood	7	0.2
	10	*Quercus* sp.	oak	wood	9	0.1
	12	*Quercus* sp.	oak	wood	7	0.3
	13	no carbonized plant remains	NA	–	–	–
Subtotal					40	1.1
Feature 4	2	no carbonized plant remains	NA	–	–	–
	4	no carbonized plant remains	NA	–	–	–
	6	no carbonized plant remains	NA	–	–	–
	14	no carbonized plant remains	NA	–	–	–
	15	*Quercus* sp.	oak	wood	7	0.1
	17	no carbonized plant remains	NA	–	–	–
Subtotal					7	0.1
Feature 5	1	*Celtis* sp.	hackberry	wood	2	0.3
		Indeterminate	NA	wood	2	0.1
		Quercus sp.	oak	acorn	2	0.1
		Quercus sp.	oak	wood	14	2.0
		Rosaceae	rose family wood type	wood	3	0.1
		Ulmus sp.	elm	wood	4	0.1
Subtotal					27	2.7
Feature 6	8	indeterminate	NA	wood	1	0.1
Subtotal					1	0.1
Feature 7	5	no carbonized plant remains	NA	–	–	–
	11	indeterminate	NA	wood	6	0.1
Subtotal					6	0.1
Feature 8	16	no carbonized plant remains	NA	–	–	–
Nonfeature	9	no carbonized plant remains	NA	–	–	–
Total					81	4.1

impossible to identify small bulb fragments, much less the taxon from which they originated.

But recognizing that the Wilson-Leonard plant specimens were bulbs failed to provide many clues to their specific identity. No keys or reference collections exist for identifying charred plant bulbs. As a result, a method had to be designed to provide the analyst with comparative evidence to support identification of archeological bulb specimens. The method devised is described in Dering (1998b) and briefly repeated in the current report. Because the method involves microscopic examination of small fragments of the bulb scale surface, it is now possible to recognize and identify small fragments of bulbs that previously were overlooked.

Bulb fragments and complete bulbs have now been recovered from several sites on the southern and eastern edges of the Edwards Plateau. Sites situated at the border between the Edwards Plateau and the Blackland Prairie and tributary streams that flow from the escarpment into the prairie also have yielded remains of bulbs. Although it is not unusual to find bulbs in sites across the Edwards Plateau (Dering 1997), there is a pattern emerging in the archeological evidence from the eastern edge of the plateau that suggests intense prehistoric cooking of bulbs, including wild onion and eastern camas, in earth ovens.

To date, the Wilson-Leonard site has provided the best-documented example of bulbs recovered from fire-cracked rock (FCR) features at an open site. A total of 11 bulbs were point-collected from the matrix of two FCR features (Table B.6). Radiocarbon assays were secured directly from 10 of these bulbs. Burned Rock Midden 2, a Late Archaic feature, contained a bulb that was dated to 3780 ± 70 B.P. Feature 181, an Early Archaic earth oven, contained several bulbs, from which nine assays were secured. The average age for these was 7997 B.P. (Stafford 1998:1054).

Recovery of identifiable plant food remains from all of these sites is very inconsistent. For example, 460 macroplant remains and 76 flotation samples from the Wilson-Leonard site (41WM235) yielded little information about plant food resources. Only 3 of the 76 flotation samples contained identifiable charred plant remains. Despite the dismal recovery, nine charred bulbs were point-collected from a single feature, and AMS assays from each of them yielded dates that clustered around 8000 B.P. At Blockhouse Creek sites in Williamson County, 62 unproductive samples (no identifiable charred plant remains) were recorded during analysis of 120 flotation samples from a series of Late Archaic and Late Prehistoric burned rock middens, yet five of the samples contained plant bulb fragments identified as wild onion.

We now have a record of at least four different bulb taxa identified from archeological sites in Texas—eastern camas, wild onion, false garlic, and rain lily. Plant bulbs have been recovered from well-described burned rock features at Hinds Cave (41VV456), the Wilson-Leonard site (41WM235), the Jonas Terrace site (41ME29), Block House Creek (41WM632), Horn Shelter (41BQ4), Rice's Crossing (41WM815), and now 41CV595 on Fort Hood (Brownlow 2000; Dering 1995, 1996, 1998a, 1999a, 1999b, 2000). All of these sites are situated on or near the eastern or southern edge of the Edwards Plateau.

In Area 2 of 41CV595, there are rock-lined pit features (Features 8, 11, and 15) that appear to be earth oven remnants, a dense layer of burned rocks that appears to be residue discarded from clean-out of earth ovens, and camas and wild onion bulbs found in one oven and on the living surface. This evidence suggests that processing and cooking plant foods, particularly root storage organs of selected plants, were important activities. Based on nine radiocarbon dates from Area 2, these activities occurred there many times during the last 2,000 years.

Table B.6. Radiocarbon assays on charred *Camassia scilloides* bulbs from the Wilson-Leonard site, 41WM235

Sample No.	Provenience	Laboratory No.	Age (B.P.)
CH-925	Burned Rock Midden 2	Beta-81106	3780 ± 70
CH-1483-1	Feature 181	CAMS-13840	7870 ± 60
CH-1479	Feature 181	CAMS-13841	7890 ± 60
CH-1478	Feature 181	CAMS-13844	7890 ± 80
C14-219	Feature 181	CAMS-8355	7990 ± 60
CH-1482	Feature 181	CAMS-13512	8010 ± 60
CH-1483-2	Feature 181	CAMS-13513	8030 ± 60
C14-354	Feature 181	CAMS-10201	8080 ± 60
CH-1484	Feature 181	CAMS-13514	8080 ± 70
CH-1480	Feature 181	CAMS-13509	8130 ± 70
CH-998	Stratum IIIcY	CAMS-18375	8250 ± 80

Note: Adapted from Stafford 1998:Table 25-3

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APPENDIX C: Analysis of Fatty Acid Compositions of Archeological Residues from 41CV595

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INTRODUCTION

In conjunction with their Paluxy site testing and data recovery project at Fort Hood, Prewitt and Associates submitted 13 archeological samples for analysis. The samples consist of 12 burned rocks and 1 metate fragment from 41CV595. Where necessary, subsamples were taken from the top surfaces of burned rocks, as indicated with an "x." Exterior surfaces were ground off to remove any contaminants. Samples were powdered, and absorbed lipid residues were extracted with organic solvents. Fatty acid components of the lipid extracts were analyzed using gas chromatography (GC). Residues were identified using criteria developed from the decomposition patterns of experimental residues. The first section of this report outlines development of the identification criteria. Analytical procedures and results then are presented.

FATTY ACIDS AND DEVELOPMENT OF THE IDENTIFICATION CRITERIA

Introduction and Previous Research

Fatty acids are the major constituents of fats and oils (lipids) and occur in nature as triglycerides, consisting of three fatty acids attached to a glycerol molecule by ester-linkages. The shorthand convention for designating fatty acids, Cx:ywz, contains three components. The "Cx" refers to a fatty acid with a carbon chain length of x number of atoms. The "y" represents the number of double bonds or points of unsaturation, and the "wz" indicates the location of the most distal double bond on the carbon chain—closest to the methyl end. Thus, the fatty acid expressed as C18:1w9, refers to a mono-unsaturated isomer with a chain length of 18 carbon atoms with a single double bond situated nine carbons from the methyl end of the chain. In the same way, the shorthand designation C16:0 refers to a saturated fatty acid with a chain length of 16 carbons.

Their insolubility in water and relative abundance compared to other classes of lipids such as sterols and waxes make fatty acids suitable for residue analysis. Since being employed by Condamin et al. (1976), gas chromatography has been used extensively to analyze the fatty acid component of absorbed archeological residues. The composition of uncooked plants and animals provides important baseline information, but it is not possible to compare modern uncooked plants and animals directly with highly degraded archeological residues.

Unsaturated fatty acids, which are found widely in fish and plants, decompose more readily than saturated fatty acids, sterols or waxes. In the course of decomposition, simple addition reactions might occur at points of unsaturation (Solomons 1980) or peroxidation might lead to formation of a variety of volatile and nonvolatile products that continue to degrade (Frankel 1991). Peroxidation occurs most readily in fatty acids with more than one point of unsaturation.

There have been several attempts to identify archeological residues using criteria that discriminate uncooked foods (Marchbanks 1989; Skibo 1992; Loy 1994). Marchbanks' (1989) percent of saturated fatty acids (%S) criteria have been used to identify residues from a variety of materials including pottery, stone tools, and burned rocks (Collins et al. 1990; Marchbanks 1989; Marchbanks and Quigg 1990). Skibo (1992:89) could not apply the %S technique and instead used two ratios of fatty acids, C18:0/C16:0 and C18:1/C16:0. He reported that it was possible to link the uncooked foods with residues extracted from modern cooking pots actively used to prepare one type of food, but the ratios could not identify food mixtures. The usefulness of these ratios did not extend to residues extracted from archeological potsherds because the ratios of the major fatty acids in the residue changed with decomposition (Skibo 1992:97). Loy (1994) proposed using a Saturation Index (SI), determined by the ratio:SI = 1-[(C18:1+C18:2)/C12:0+C14:0+C16:0+C18:0)]. He admitted, however, that poorly understood decompositional changes to the original suite of fatty acids make it difficult to develop criteria for distinguishing animal and plant fatty acid profiles in archeological residues.

The major drawback of the distinguishing ratios Marchbanks (1989), Skibo (1992), and Loy (1994) proposed is that they have never been empirically tested. The proposed ratios are based on criteria that discriminate food classes based on their original fatty acid composition. The resistance of these criteria to the effects of decompositional changes has not been demonstrated. Rather, Skibo (1992) found his fatty acid ratio criteria could not be used to identify highly decomposed archeological samples.

To identify a fatty acid ratio unaffected by degradation processes, Patrick et al. (1985) simulated the long-term decomposition of one sample and monitored the resulting changes. An experimental cooking residue of seal was prepared and degraded to identify a stable fatty acid ratio. Patrick et al. (1985) found that the ratio of two C18:1 isomers, oleic and vaccenic, did not change with decomposition; this fatty acid ratio was then used to identify an archeological vessel residue as seal. Although the fatty acid composition of uncooked foods must be known, Patrick et al. (1985) showed that the long-term effects of cooking and decomposition on the fatty acids must also be understood.

Developing Identification Criteria

As the first stage in developing the identification criteria used herein, the fatty acid compositions of more than 130 uncooked native food plants and animals from Western Canada were determined using gas chromatography (Malainey 1997; Malainey et al. 1999a). When the fatty acid compositions of modern food plants and animals were subject to cluster and principal component analyses, the resultant groupings generally corresponded to divisions that exist in nature (Table C.1). Clear differences in the fatty acid composition of large mammal fat, large herbivore meat, fish, plant roots, greens and berries-seeds-nuts were detected, but the fatty acid composition of meat from medium-sized mammals resembles berries-seeds-nuts.

Samples in cluster A, the large mammal and fish cluster, had elevated levels of C16:0 and C18:1 (Table C.1). Divisions within this cluster stemmed from the very high level of C18:1 isomers in fat, high levels of C18:0 in bison and deer meat, and high levels of very long chain unsaturated fatty acids (VLCU) in fish. Differences in the fatty acid composition of plant roots, greens, and berries-seeds-nuts reflect the amounts of C18:2 and C18:3w3 present. The berry, seed, nut, and small mammal meat samples appearing in cluster B have very high levels of C18:2, ranging from 35 percent to 64 percent (Table C.1). Samples in subclusters V, VI, and VII have levels of C18:1 isomers from 29 percent to 51 percent as well. Plant roots, plant greens and some berries appear in cluster C. All cluster C samples have moderately high levels of C18:2; except for the berries in subcluster XII, levels of C16:0 are also elevated. Higher levels of C18:3w3 or very long chain saturated fatty acids (VLCS) are also common, except in the roots that form subcluster XV.

The effects of cooking and degradation over time on fatty acid compositions also were examined. Originally, 19 modern residues of plants and animals from the plains, parkland, and forests of Western Canada were prepared by cooking samples of meats, fish, and plants, alone or combined, in replica vessels over an open fire (Malainey 1997; Malainey et al. 1999b). After four days at room temperature, the vessels were broken, and a set of sherds was analyzed to determine changes after short-term decomposition. A second set of sherds remained at room temperature for 80 days, then was placed in an oven at 75°C for a period of 30 days to simulate long-term decomposition. The relative percentages were calculated based on the 10 fatty acids (C12:0, C14:0, C15:0, C16:0, C16:1, C17:0, C18:0, C18:1w9, C18:1w11, C18:2) that regularly appeared in Precontact period vessel residues from Western Canada. Observed changes in fatty acid composition of the experimental cooking residues allowed development of a method for identifying the archeological residues (Table C.2).

It was determined that levels of medium chain fatty acids (C12:0, C14:0, and C15:0), C18:0 and C18:1 isomers in the sample could be used to distinguish degraded experimental cooking residues (Malainey 1997; Malainey et al. 1999b). These fatty acids are suitable for the identification criteria because saturated fatty acids are stable and the mono-unsaturated fatty acid degrades very slowly compared to polyunsaturated fatty acids (deMan 1992). Higher levels of medium chain fatty acids, combined with low levels of C18:0 and C18:1 isomers, were detected in the decomposed experimental residues of plants, such as roots, greens and most berries. High levels of C18:0 indicated the presence of large herbivores. Moderate levels of C18:1 isomers, with low levels of C18:0, indicated the presence of either fish or foods similar in composition to corn. High levels of C18:1 isomers with low levels of C18:0, were found in residues of beaver or foods of similar fatty acid composition. The criteria for

Table C.1. Summary of average fatty acid composition of modern food groups generated by hierarchical cluster analysis

Cluster	A				B						C				
Sub-cluster	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**	**XI**	**XII**	**XIII**	**XIV**	**XV**
Type	Mammal fat and marrow	Large herbivore meat	Fish	Fish	Berries and nuts	Mixed	Seeds and berries	Roots	Seeds	Mixed	Greens	Berries	Roots	Greens	Roots
C16:0	19.90	19.39	16.07	14.10	3.75	12.06	7.48	19.98	7.52	10.33	18.71	3.47	22.68	24.19	18.71
C18:0	7.06	20.35	3.87	2.78	1.47	2.36	2.58	2.59	3.55	2.43	2.48	1.34	3.15	3.66	5.94
C18:1	56.77	35.79	18.28	31.96	51.14	35.29	29.12	6.55	10.02	15.62	5.03	14.95	12.12	4.05	3.34
C18:2	7.01	8.93	2.91	4.04	41.44	35.83	54.69	48.74	64.14	39.24	18.82	29.08	26.24	16.15	15.61
C18:3	0.68	2.61	4.39	3.83	1.05	3.66	1.51	7.24	5.49	19.77	35.08	39.75	9.64	17.88	3.42
VLCS	0.16	0.32	0.23	0.15	0.76	4.46	2.98	8.50	5.19	3.73	6.77	9.10	15.32	18.68	43.36
VLCU	0.77	4.29	39.92	24.11	0.25	2.70	1.00	2.23	0.99	2.65	1.13	0.95	2.06	0.72	1.10

Note: Numbers are percentages. VLCS = Very Long Chain (C20, C22, and C24) Saturated Fatty Acids; VLCU = Very Long Chain (C20, C22, and C24) Unsaturated Fatty Acids.

identifying six types of residues were established experimentally; the seventh type, plant with large herbivore, was inferred (see Table C.2). These criteria were applied to residues extracted from more than 200 pottery cooking vessels from 18 Western Canadian sites (Malainey 1997; Malainey et al. 1999c; Malainey, Przybylski, and Sherriff 2001). The identifications were found to be consistent with the evidence from faunal and tool assemblages for each site.

Work has continued to explore the decomposition patterns of various foods and food combinations (Malainey et al. 2000a, 2000b, 2000c; Malainey, Malisza, et al. 2001; Quigg et al. 2001). The collection of modern foods has expanded to include plants from the Southern Plains. The fatty acid compositions of mesquite beans (*Prosopis glandulosa*), Texas ebony seeds (*Pithecellobium ebano Berlandier*), tasajillo berry (*Opuntia leptocaulis*), prickly pear fruit and pads (*Opuntia engelmannii*), Spanish dagger pods (*Yucca treculeana*), cooked sotol (*Dasylirion wheeler*), agave (*Agave lechuguilla*), cholla (*Opuntia imbricata*), piñon (*Pinus edulis*), and Texas mountain laurel (or mescal) seed (*Sophora secundiflora*) have been determined. Experimental residues of many of these plants, alone or in combination with deer meat, have been prepared by boiling foods in clay cylinders or using sandstone for either stone boiling (Quigg 1999) or as a griddle.

To accelerate the oxidative degradation that naturally occurs at a slow rate with the passage of time, the rock or clay tile containing the experimental residue was placed in an oven at 75°C. After either 30 or 68 days, residues were extracted and analyzed using gas chromatography.

The results of these decomposition studies allowed identification criteria to be refined.

METHODOLOGY

Descriptions of the 13 samples are presented in Table C.3. Possible contaminants were removed by grinding off exterior surfaces with a Dremel® tool fitted with a silicon carbide bit. Immediately thereafter, the sample was crushed with a hammer mortar and pestle, and the powder transferred to an Erlenmeyer flask. Lipids were extracted using a variation of the method developed by Folch et al. (1957). The powdered sample was mixed with a 2:1 mixture, by volume, of chloroform and methanol (2 X 30 mL) using ultrasonication (2 X 10 min). Solids were removed by filtering the solvent mixture into a separatory funnel. The lipid-solvent filtrate was washed with 16 mL of double distilled water. Once separation into two phases was complete, the lower chloroform-lipid phase was transferred to a round-bottomed flask, and the chloroform removed by rotary evaporation. Any remaining water was removed by evaporation with benzene (1.5 mL); 1.5 ml of chloroform and methanol (2:1) was used to transfer the dry total lipid extract to a screw-top glass vial with a Teflon®-lined cap. The sample was flushed with nitrogen and stored in a -20°C freezer.

A 450 mL sample of the total lipid extract solution was placed in a screw-top test tube and dried in a heating block under nitrogen. Fatty acid methyl esters (FAMES) were prepared by treating the dry lipid with 6 mL of 0.5 N anhydrous hydrochloric acid in methanol (65–70°C; 60 min). Fatty acids that occur in the sample as di- or triglycerides are detached from the glycerol molecule and converted to methyl esters. After cooling to room temperature, 4 mL of ultrapure water was added. FAMES were recovered with petroleum ether (3 mL) and transferred to a vial. The solvent was removed by heat

Table C.2. Criteria for identifying archeological residues based on decomposition patterns of experimental cooking residues prepared in pottery vessels

Identification	Medium Chain	C18:0	C18:1 isomers
Large herbivore	<15%	>27.5%	<15%
Large herbivore with plant or bone marrow	Low	>25%	15%<X<25%
Plant with large herbivore	>15%	>25%	no data
Beaver	Low	Low	>25%
Fish or corn	Low	<25%	15%<X<27.5%
Fish or corn with plant	>15%	<25%	15%<X<27.5%
Plant (except corn)	>10%	<27.5%	<15%

Table C.3. List of samples analyzed, 41CV595

Lab No.	Field Sample No.	Excavation Area	Test Unit	Feature Association	Material	Sample Size (g)
PAI 1	BR-1-1	3	62	F5, burned rock cluster, possibly a dump	burned rock	46.66
PAI 2	BR-1-3	3	62	F5, burned rock cluster, possibly a dump	burned rock	55.49
PAI 3	BR-9	2	32	F10, burned rock cluster, possibly a dump	burned rock	38.67
PAI 4	BR-13	2	27	F8, earth oven	burned rock	58.25
PAI 5	BR-14	2	33	F8, earth oven	burned rock	53.66
PAI 6	BR-15	2	27	F8, earth oven	burned rock	39.42
PAI 7	BR-17	2	35	F11, earth oven	burned rock	38.73
PAI 8	BR-18	2	35	F11, earth oven	burned rock	36.80
PAI 9	BR-19	2	35	F11, earth oven	burned rock	29.55
PAI 10	BR-25	2	50	F15, earth oven	burned rock	52.54
PAI 11	BR-26	2	50	F15, earth oven	burned rock	26.53
PAI 12	BR-28	2	43	F15, earth oven	burned rock	42.16
PAI 13	–	2	25	none	complete metate	32.97

under a gentle stream of nitrogen; the FAMES were dissolved in 75 µL of *iso*-octane transferred to a GC vial with a conical glass insert.

Solvents and chemicals were checked for purity by running a sample blank. The entire lipid extraction and methyl esterification process was performed, and FAMES were dissolved in 75 mL of *iso*-octane. Traces of contamination were subtracted from the sample chromatogram. The relative percentage composition was calculated by dividing the integrated peak area of each fatty acid by the total area of fatty acids present in the sample.

The step in extraction in which the chloroform, methanol, and lipid mixture is washed with water is standard procedure for extracting lipids from modern samples. Following Evershed et al. (1990), who reported that this step was unnecessary for analyzing archeological residues, the solvent-lipid mixture was not washed beforehand. This step was recently adopted to remove impurities so that a clearer chromatogram could be obtained in the region where very long chain fatty acids (C20:0, C20:1, C22:0, and C24:0) occur. It was anticipated that detecting and accurately assessing these fatty acids could be instrumental in separating residues of animal origin from those of plant (Malainey et al. 2000a, 2000b, 2000c; Malainey, Malisza et al. 2001).

To identify the residue, the relative percentage composition was determined first with respect to all fatty acids present in the sample (including very long chain fatty acids) (Table C.4) and second with respect to the 10 fatty acids used in developing the identification criteria (C12:0, C14:0, C15:0, C16:0, C16:1, C17:0, C18:0, C18:1w9, C18:1w11 and C18:2) (not shown). The second step is necessary for applying the identification criteria presented in Table C.2.

It must be understood that the identifications given do not necessarily mean that those particular foods were actually prepared because different foods of similar fatty acid composition and lipid content would produce similar residues. It is possible only to say that the material of origin for the residue was similar in composition to the food(s) indicated.

Gas Chromatography Analysis Parameters

The GC analysis was performed on a Hewlett-Packard 5890 gas chromatograph fitted with a flame ionization detector connected to a personal computer. Samples were separated using a DB-23 fused silica capillary column (30 m X 0.25 mm I.D.; J&W Scientific; Folsom, Calif.). An autosampler injected a 3 mL sample using a split injection system with the ratio set

Table C.4. Fatty acid composition and identification of residues, 41CV595

	PAI 1		PAI 2		PAI 3		PAI 4	
Fatty acid	Area	Rel%	Area	Rel%	Area	Rel%	Area	Rel%
C12:0	1567	1.62	4276	2.87	2753	1.46	8325	1.22
C14:0	2283	2.36	4054	2.72	3099	1.64	6929	1.01
C14:1	0	0.00	644	0.43	0	0.00	0	0.73
C15:0	1604	1.66	1570	1.05	840	0.45	7373	1.08
C16:0	45868	47.35	68887	46.24	101443	53.75	315651	46.07
C16:1	802	0.83	2053	1.38	1396	0.74	53153	7.76
C17:0	0	0.00	1646	1.10	985	0.52	1984	0.29
C17:1	0	0.00	0	0.00	0	0.00	0	0.00
C18:0	3342	3.45	8827	5.92	14210	7.53	15567	2.27
C18:1s	24926	25.73	35988	24.15	52352	27.74	229621	33.52
C18:2	7210	7.44	10414	6.99	0	0.00	31349	4.58
C18:3w3	4478	4.62	1813	1.22	5013	2.66	1894	0.28
C20:0	1990	2.05	3743	2.51	5178	2.74	4799	0.00
C20:1	839	0.87	2805	1.88	0	0.00	7145	1.04
C24:0	1249	2.02	6922	1.21	8951	0.77	8540	0.00
C24:1	0	0.00	2922	0.31	2187	0.00	7675	0.17
Total	96158	100.00	156564	100.00	198407	100.00	700005	100.00
Identification	Borderline medium and moderate-high fat content food		Medium fat content food (mesquite/corn)		Moderate-high fat content food (Texas ebony/beaver)		Moderate-high fat content food (Texas ebony/beaver)	

	PAI 5		PAI 6		PAI 7		PAI 8	
Fatty acid	Area	Rel%	Area	Rel%	Area	Rel%	Area	Rel%
C12:0	46066	3.35	15267	2.21	4332	1.67	3626	1.75
C14:0	42038	3.05	14255	2.06	8127	3.14	6336	3.06
C14:1	52605	3.82	17513	2.53	0	4.97	0	3.10
C15:0	9484	0.69	4558	0.66	1520	0.59	1195	0.58
C16:0	476296	34.59	225265	32.56	106208	41.01	78542	37.98
C16:1	79043	5.74	2981	0.43	3773	1.46	1916	0.93
C17:0	0	0.00	0	0.00	1797	0.69	954	0.46
C17:1	0	0.00	0	0.00	0	0.00	0	0.00
C18:0	40132	2.91	34968	5.05	11991	4.63	12840	6.21
C18:1s	516362	37.49	296089	42.79	102902	39.74	81984	39.64
C18:2	70844	5.14	54111	7.82	0	0.00	9921	4.80
C18:3w3	0	0.00	6066	0.88	0	0.00	0	0.00
C20:0	5612	0.41	5687	0.82	3713	1.43	3937	0.00
C20:1	14617	1.06	6700	0.97	0	0.00	2718	1.31
C24:0	11673	1.75	11832	0.97	7418	0.67	7201	0.00
C24:1	8786	0.00	4098	0.25	2854	0.00	1069	0.18
Total	1373558	100.00	699390	100.00	254635	100.00	212239	100.00
Identification	High fat content food (seed/animal fat or combination)		High fat content food (seed/animal fat or combination)		High fat content food (seed/animal fat or combination		High fat content food (seed/animal fat or combination)	

Table C.4, continued

	PAI 9		PAI 10		PAI 11		PAI 12	
Fatty acid	Area	Rel%	Area	Rel%	Area	Rel%	Area	Rel%
C12:0	0	0.00	407	0.36	1765	2.22	2766	1.56
C14:0	2095	1.21	1756	1.54	1056	1.33	2945	1.66
C14:1	0	0.00	0	0.00	0	1.30	0	0.61
C15:0	0	0.00	957	0.84	849	1.07	400	0.23
C16:0	65752	38.10	58154	51.15	27075	34.05	85605	48.38
C16:1	0	0.00	1364	1.20	470	0.59	5443	3.08
C17:0	4387	2.54	768	0.68	647	0.81	384	0.22
C17:1	0	0.00	0	0.00	0	0.00	627	0.35
C18:0	11383	6.60	10164	8.94	8458	10.64	7888	4.46
C18:1s	83813	48.57	31217	27.46	22045	27.72	49465	27.96
C18:2	13544	0.00	7588	6.67	0	7.43	12654	7.15
C18:3w3	0	0.00	0	0.00	4543	5.71	237	0.13
C20:0	3979	2.31	4698	0.00	3066	3.86	2771	1.57
C20:1	2086	0.00	1072	0.94	0	0.96	2324	1.31
C24:0	7343	0.67	9356	0.00	2549	2.31	2285	1.05
C24:1	552	0.00	621	0.21	0	0.00	639	0.27
Total	194934	100.00	128122	100.00	72523	100.00	176433	100.00
Identification	High fat content food (seed/animal fat or combination)		Borderline medium and moderate-high fat content food		Moderate-high fat content food (Texas ebony/beaver)		Moderate-high fat content food (Texas ebony/beaver)	

	PAI 13	
Fatty acid	Area	Rel%
C12:0	669	0.75
C14:0	6380	7.12
C14:1	0	1.09
C15:0	9493	10.59
C16:0	31477	35.13
C16:1	1025	1.14
C17:0	736	0.82
C17:1	0	0.00
C18:0	5851	6.53
C18:1s	27281	6.53
C18:2	0	0.00
C18:3w3	3038	3.39
C20:0	2012	2.25
C20:1	0	0.00
C24:0	2775	0.74
C24:1	0	0.00
Total	90737	100.00
Identification	Moderate-high fat content food + plant or bird + plant	

at 1:20. Hydrogen was used as the carrier gas at a linear velocity of approximately 40 cm/sec. Column temperature was programmed from 155^{o} to $215^{o}C$ at $2^{o}C$ per minute. The lower temperature was held for 4 minutes; the upper temperature was held for 12 minutes. The chromatogram peaks were integrated using ChromPerfect® software and identified through comparisons with several external qualitative standards (NuCheck Prep; Elysian, MN). Using this procedure, fatty acids are detectable to the nanogram (1×10^{-9} g) level.

RESULTS OF ARCHEOLOGICAL DATA ANALYSIS

The fatty acid compositions of residues extracted from 13 samples are presented in Table C.4. The term Area represents the area under the chromatographic peak of a given fatty acid, as calculated by the ChromPerfect® software minus the solvent blank. The term, Rel%, represents the relative percentage of the fatty acid with respect to the total fatty acids in the sample. Because hydroxide or peroxide degradation products can interfere with the integration of the C22:0 and C22:1 peaks, these fatty acids were excluded from the analysis.

All of the residues from 41CV595 have fairly high fat contents. Residues from low-fat root plants such as onion (*Allium* sp.) and camas (*Camassia scilloides*) would have high levels of medium or very long chain saturated fatty acids with low levels of C18:0 and C18:1 isomers. Based on relatively low levels of C18:0 in all samples, large herbivore products appear to be absent from all residues.

The compositions of five residues, PAI 5–9, are similar and characterized by very high levels of C18:1 isomers, between about 37.5 percent and 48.6 percent. This value is somewhat higher than one would expect in residues from foods of moderate-high fat content, such as Texas ebony and beaver meat, but it is slightly lower than would be produced by a very high-fat content food, such as piñon nuts. Possible candidates for these residues include pure mammal fat (other than large herbivore) or locally available high fat content seeds and nuts (such as pecans and oak acorns). A combination of a medium-high fat food and very high-fat content could also produce similar residues.

Four residues—PAI 3, 4, 11 and 12—are typical of foods of moderate-high fat content. These residues have relatively high levels of C18:1 isomers and relatively low levels of C18:0. Examples of moderate-high fat content foods include Texas ebony seeds and the fatty meat of medium-sized mammals, such as beaver. Residue PAI 11 has slightly elevated levels of medium chain and very long chain saturated fatty acids, suggesting it could be of plant origin. The origins of residues PAI 3, 4, and 12 are less clear.

Residue PAI 13, from the grinding basin of a complete metate, is similar to the residues described above, except that levels of two medium chain fatty acids, C14:0 and C15:0, are quite high. It is most likely that the residue results from preparing a moderate-high fat content food in combination with low-fat plant (roots and greens). Some birds, for example grouse, produce similar residues with moderate-high levels of C18:1 isomers and elevated levels of C14:0. Given the high level of C15:0, a combination of bird and low-fat plant is more likely than bird alone.

Residue PAI 2 appears to result from preparing medium-fat content foods, such as mesquite or corn. This residue has elevated levels of C18:1 isomers and relatively lower levels of C18:0. Fish also produces similar residues, but given the slightly elevated levels of medium chain and very long chain saturated fatty acids, a plant origin is most probable. In many respects, residue PAI 1 is very similar to PAI 2, but the C18:1 isomer level is slightly higher in the former residue. Both PAI 1 and another residue, PAI 10, fall on the border between medium- and moderate-high fat content foods.

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APPENDIX D: Provenience of Artifacts Recovered from 41CV595

Table D.1. Summary of provenience data for all artifacts recovered, 41CV595, by area

Test Unit	Elevation (m)	Feature	Other Provenience	Arrow point	Arrow point preform	Dart point	Dart point preform	Perforator	Early- to middle-stage biface	Late-stage to finished biface	Miscellaneous biface	End scraper	Side scraper	Miscellaneous uniface	Spoke shave	Graver-Burin	Core tool	Edge-modified flake	Core	Tested cobble	Unmodified flake	Metate	Other ground stone	Hammerstone	Total
AREA 1																									
–	–	–	backdirt	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1
5	98.70–98.60	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	5
5	98.60–98.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	14	–	–	–	14
5	98.50–98.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	9	–	–	–	10
5	98.40–98.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
5	98.20–98.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
5	98.10–98.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
5	98.00–97.90	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
5	97.90–97.80	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
5	97.80–97.70	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
6	98.80–98.70	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	5
6	98.70–98.60	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	5
6	98.60–98.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8	–	–	–	8
6	98.50–98.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	5	–	–	–	6
6	98.40–98.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
6	98.30–98.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
6	98.20–98.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
6	98.10–98.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
6	98.10–97.99	6	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
7	98.80–98.70	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	3	–	–	1	5
7	98.70–98.60	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	11	–	–	–	12
7	98.60–98.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	11	–	–	–	11
7	98.40–98.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	3	–	–	–	5
7	98.30–98.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
7	98.28	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1		–	–	–	1
7	98.20–98.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3

Table D.1, continued

Test Unit	Elevation (m)	Feature	Other Provenience	Arrow point	Arrow point preform	Dart point	Dart point preform	Perforator	Early- to middle-stage biface	Late-stage to finished biface	Miscellaneous biface	End scraper	Side scraper	Miscellaneous uniface	Spoke shave	Graver-Burin	Core tool	Edge-modified flake	Core	Tested cobble	Unmodified flake	Metate	Other ground stone	Hammerstone	Total
7	98.10–98.00	–		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
7	98.10–97.98	6	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
Area 1 Subtotal				0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	1	114	1	0	1	123
AREA 2																									
8	99.50–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8	–	–	–	8
9	99.45–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8	–	–	–	8
10	99.60–99.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	5
10	99.50–99.40	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	8	–	–	–	9
11	99.50–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	20	–	–	–	20
12	99.65–99.60	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
12	99.60–99.50	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	6
12	99.50–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	5
12	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
13	99.66–99.60	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
13	99.60–99.50	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	8	–	–	–	9
13	99.50–99.40	–	–	–	–	–	–	–	1	–	–	–	–	1	–	–	–	2	–	–	12	–	–	–	16
13	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	5	–	–	–	6
13	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
14	99.50–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
15	99.59–99.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
15	99.50–99.40	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	3
16	99.63–99.60	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
16	99.60–99.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	19	–	–	–	20
16	99.50–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	25	–	–	–	26
16	99.41	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
16	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3

Table D.1, continued

Test Unit	Elevation (m)	Feature	Other Provenience	Arrow point	Arrow point preform	Dart point	Dart point preform	Perforator	Early- to middle-stage biface	Late-stage to finished biface	Miscellaneous biface	End scraper	Side scraper	Miscellaneous uniface	Spoke shave	Graver-Burin	Core tool	Edge-modified flake	Core	Tested cobble	Unmodified flake	Metate	Other ground stone	Hammerstone	Total
16	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
17	99.57–99.50	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	30	–	–	–	31
17	99.50–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	20	–	–	–	20
17	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	8	–	–	–	9
17	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
18	99.57–99.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	5
18	99.50–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	32	–	–	–	32
18	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	10	–	–	–	10
18	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	5
18	99.20–99.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
19	99.49–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	11	–	–	–	11
19	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
19	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
19	99.20–99.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
20	99.67–99.60	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
20	99.60–99.50	–	–	–	–	–	–	–	–	1	–	–	–	–	–	1	–	–	–	–	10	–	–	–	12
20	99.50–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
21	99.68–99.60	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	–	–	–	6
21	99.60–99.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	11	–	–	–	11
21	99.50–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	10	–	–	–	11
21	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
21	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
22	99.60–99.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	16	–	–	–	16
22	99.50–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	21	–	–	–	21
22	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	–	–	–	7
22	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
22	99.20–99.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
23	99.55–99.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	11	–	–	–	11

Table D.1, continued

Test Unit	Elevation (m)	Feature	Other Provenience	Arrow point	Arrow point preform	Dart point	Dart point preform	Perforator	Early- to middle-stage biface	Late-stage to finished biface	Miscellaneous biface	End scraper	Side scraper	Miscellaneous uniface	Spoke shave	Graver-Burin	Core tool	Edge-modified flake	Core	Tested cobble	Unmodified flake	Metate	Other ground stone	Hammerstone	Total
23	99.50–99.40	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	16	–	–	–	16
23	99.40–99.30	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13	–	–	–	13
23	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
24	99.52–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	20	–	–	–	20
24	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	19	–	–	–	20
24	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	5
24	99.20–99.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
25	99.55–99.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
25	99.50–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
25	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
25	99.10–99.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
25	98.97	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		1	–	–	1
26	99.50–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
26	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13	–	–	–	13
26	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
27	99.67–99.60	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
27	99.60–99.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	–	–	–	7
27	99.55–99.11	8	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	36	–	–	–	37
27	99.42	8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–		–	–	–	1
28	99.55–99.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	–	–	–	6
28	99.50–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13	–	–	–	13
28	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	11	–	–	–	12
28	99.40	8	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–		–	–	–	1
29	99.70–99.57	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–	–	1
29	99.57–99.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
29	99.55–99.19	8	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	23	–	–	–	23

Table D.1, continued

Test Unit	Elevation (m)	Feature	Other Provenience	Arrow point	Arrow point preform	Dart point	Dart point preform	Perforator	Early- to middle-stage biface	Late-stage to finished biface	Miscellaneous biface	End scraper	Side scraper	Miscellaneous uniface	Spoke shave	Graver-Burin	Core tool	Edge-modified flake	Core	Tested cobble	Unmodified flake	Metate	Other ground stone	Hammerstone	Total
29	99.50–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	34	–	–	–	35
29	99.48–99.40	12	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	–	–	–	6
29	99.40–99.30	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	1	–	–	13	–	–	–	16
29	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
29	99.20–99.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
30	99.60–99.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	12	–	–	–	12
30	99.50–99.40	*	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	17	–	–	–	18
30	99.40–99.30	*	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	27	–	–	–	28
30	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	12	–	–	–	13
31	99.45–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8	–	–	–	8
31	99.45	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–	–	1
31	99.40–99.30	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9	–	–	–	9
31	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
31	99.25–99.03	11	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	17	–	–	–	17
31	99.20–99.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
32	99.40–99.30	*	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	5
32	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
33	99.54–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	5	–	–	–	6
33	99.54–99.00	8	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9	–	–	–	9
33	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	–	–	–	6
34	99.50–99.40	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	4	–	–	–	5
34	99.40–99.30	–		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	5
34	99.31–99.09	11	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	–	–	–	6
34	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2

Table D.1, continued

Test Unit	Elevation (m)	Feature	Other Provenience	Arrow point	Arrow point preform	Dart point	Dart point preform	Perforator	Early- to middle-stage biface	Late-stage to finished biface	Miscellaneous biface	End scraper	Side scraper	Miscellaneous uniface	Spoke shave	Graver-Burin	Core tool	Edge-modified flake	Core	Tested cobble	Unmodified flake	Metate	Other ground stone	Hammerstone	Total
34	99.20–99.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
35	99.44–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
35	99.40–99.30	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13	–	–	–	13
35	99.33–98.99	11	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	11	–	–	–	12
35	99.20–99.10	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
35/31	99.02–98.91	–	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
36	99.38–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	3	–	–	–	4
36	99.30–99.20	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	10	–	–	–	11
36	99.21–99.03	11	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8	–	–	–	8
36	99.20–99.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
36	99.10–99.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	2	–	–	–	3
36	99.00–98.90	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
37	99.60–99.50	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	16	–	–	–	18
37	99.50–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	21	–	–	–	21
37	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	–	–	–	7
37	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
38	99.55–99.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	–	–	–	6
38	99.50–99.40	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	36	–	–	–	37
38	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	6	–	–	–	7
38	99.20–99.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
39	99.58–99.50	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13	–	–	–	14
39	99.50–99.40	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	49	–	–	–	50
39	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	15	–	–	–	15
39	99.30–99.20	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	4

Table D.1, continued

Test Unit	Elevation (m)	Feature	Other Provenience	Arrow point	Arrow point preform	Dart point	Dart point preform	Perforator	Early- to middle-stage biface	Late-stage to finished biface	Miscellaneous biface	End scraper	Side scraper	Miscellaneous uniface	Spoke shave	Graver-Burin	Core tool	Edge-modified flake	Core	Tested cobble	Unmodified flake	Metate	Other ground stone	Hammerstone	Total
40	99.50–99.40	*	–	–	–	2	–	–	–	1	–	–	–	–	–	–	–	–	–	–	19	–	–	–	22
40	99.40–99.30	*	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	–	–	–	22	–	–	–	24
40	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
40	99.20–99.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
40	99.10–99.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
41	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	–	–	–	7
41	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9	–	–	–	9
41	99.20–99.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
42	99.30–99.20	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	–	–	–	6
42	99.20–99.10	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
42	99.05–99.02	*	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
42	99.01–98.93	15	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	–	–	–	6
42	99.00–98.90	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
42/43	99.04–98.98	*	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
43	99.20–99.10	*	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	1	–	2	–	–	–	4
43	99.10–99.00	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	16	–	–	–	17
43	99.09–98.91	15	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	–	–	–	7
43	98.99–98.89	15	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
43	98.90–98.85	–	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
43/36	99.12–98.92	*	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
44	99.57–99.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	4	–	–	–	5

Table D.1, continued

Test Unit	Elevation (m)	Feature	Other Provenience	Arrow point	Arrow point preform	Dart point	Dart point preform	Perforator	Early- to middle-stage biface	Late-stage to finished biface	Miscellaneous biface	End scraper	Side scraper	Miscellaneous uniface	Spoke shave	Graver-Burin	Core tool	Edge-modified flake	Core	Tested cobble	Unmodified flake	Metate	Other ground stone	Hammerstone	Total
44	99.50–99.40	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	12	–	–	–	13
44	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	–	–	–	7
44	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
45	99.60–99.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	26	–	–	–	26
45	99.50–99.40	*	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	103	–	–	–	104
45	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	27	–	–	–	29
45	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
46	99.60–99.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8	–	–	–	8
46	99.50–99.40	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	28	–	–	–	28
46	99.40–99.34	*	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	14	–	–	–	14
46	99.40–99.30	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	37	–	–	–	39
46	99.30–99.20	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	5
46	99.20–99.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	5
46	99.10–99.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
46	94.77–99.53	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	1
47	99.46–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	9	–	–	–	10
47	99.40–99.30	*	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	69	–	–	–	71
47	99.30–99.20	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	12	–	–	–	12
47	99.20–99.10	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	18	–	–	–	18
47	99.10–99.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8	–	–	–	8
47	99.00–98.90	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
48	99.46–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	68	–	–	–	68
48	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	42	–	–	–	42
48	99.28	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–	–	1
48	99.20–99.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	15	–	–	–	16
48	99.10–99.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
48	99.00–98.90	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4

Table D.1, continued

Test Unit	Elevation (m)	Feature	Other Provenience	Arrow point	Arrow point preform	Dart point	Dart point preform	Perforator	Early- to middle-stage biface	Late-stage to finished biface	Miscellaneous biface	End scraper	Side scraper	Miscellaneous uniface	Spoke shave	Graver-Burin	Core tool	Edge-modified flake	Core	Tested cobble	Unmodified flake	Metate	Other ground stone	Hammerstone	Total
48	98.90–98.80	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
49	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	14	–	–	–	14
49	99.20–99.10	*	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	3	–	–	–	4
49	99.10–99.00	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	21	–	–	–	21
49	99.00–98.90	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
49	98.90–98.80	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	4	–	–	–	5
49	98.80–98.70	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	3
49	98.77	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	1	–	1
49	98.70–98.60	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
50	99.38–99.25	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–	–	1
50	99.30–99.20	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	5
50	99.20–99.10	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	16	–	–	–	16
50	99.10–99.00	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	5
50	99.03–98.87	15	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	9	–	–	–	10
50	99.00–98.86	15	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	31	–	–	–	31
50	98.98–98.89	*	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	17	–	–	–	17
50	98.90–98.80	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
50	98.80–98.70	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
51	99.50–99.40	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	1	–	45	–	–	–	47
51	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	17	–	–	–	17
51	99.40–99.26	–	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
51	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	1	–	5
51	99.20–99.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
52	99.49–99.40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	60	–	–	–	61

Table D.1, continued

Test Unit	Elevation (m)	Feature	Other Provenience	Arrow point	Arrow point preform	Dart point	Dart point preform	Perforator	Early- to middle-stage biface	Late-stage to finished biface	Miscellaneous biface	End scraper	Side scraper	Miscellaneous uniface	Spoke shave	Graver-Burin	Core tool	Edge-modified flake	Core	Tested cobble	Unmodified flake	Metate	Other ground stone	Hammerstone	Total
52	99.44–99.37	14	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
52	99.40–99.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	29	–	–	–	29
52	99.30–99.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
52	99.20–99.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
Area 2 Subtotal				0	1	15	0	0	10	7	1	1	1	3	1	3	1	20	12	0	1,999	1	2	0	2,078
AREA 3																									
–	–	–	backdirt	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
53	95.90–95.80	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
53	96.00–95.90	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	2
53	96.10–96.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	–	–	–	7
53	96.20–96.10	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	1	–	–	26	–	–	–	28
53	96.24–96.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	10	–	–	–	10
54	95.90–95.80	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–		–	–	–	1
54	96.00–95.90	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	9	–	–	–	10
54	96.10–96.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	30	–	–	–	31
54	96.20–96.10	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	38	–	–	–	40
54	96.28–96.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
55	95.80–95.70	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
55	95.90–95.80	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
55	96.00–95.90	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	10	–	–	–	10
55	96.10–96.00	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	43	–	–	–	44
55	96.20–96.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	27	–	–	–	27
55	96.27–96.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	5
56	95.60–95.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
56	95.70–95.60	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	2	–	–	–	3
56	95.80–95.70	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4

Table D.1, continued

Test Unit	Elevation (m)	Feature	Other Provenience	Arrow point	Arrow point preform	Dart point	Dart point preform	Perforator	Early- to middle-stage biface	Late-stage to finished biface	Miscellaneous biface	End scraper	Side scraper	Miscellaneous uniface	Spoke shave	Graver-Burin	Core tool	Edge-modified flake	Core	Tested cobble	Unmodified flake	Metate	Other ground stone	Hammerstone	Total
56	95.90–95.80	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
56	96.00–95.90	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
57	95.70–95.60	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	2	–	–	–	4
57	95.72–95.70	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	v	1	–	–	–	1
57	95.80–95.70	3	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
57	95.80–95.72	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
57	95.90–95.80	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	14	–	–	–	15
57	96.00–95.90	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	12	–	–	–	12
57	96.10–96.00	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	56	–	–	–	56
57	96.20–96.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	22	–	–	–	23
57	96.30–96.20	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	2	–	–	–	3
58	95.90–95.80	3	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
58	96.00–95.90	3	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
58	96.10–96.00	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	2
59	95.70–95.60	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
59	96.10–96.00	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	9	–	–	–	10
59	96.20–96.10	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	–	–	–	7
59	96.28–96.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
60	95.60–95.50	3	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	2
60	95.80–95.70	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
60	96.10–96.00	3	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	43	–	–	–	44
60	96.18–96.10	3	–	–	–	–	–	–	1	1	–	–	–	–	–	–	–	1	–	–	14	–	–	–	17
61	95.90–95.80	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
61	96.00–95.90	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
61	96.10–96.00	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	18	–	–	–	18

Table D.1, continued

Test Unit	Elevation (m)	Feature	Other Provenience	Arrow point	Arrow point preform	Dart point	Dart point preform	Perforator	Early- to middle-stage biface	Late-stage to finished biface	Miscellaneous biface	End scraper	Side scraper	Miscellaneous uniface	Spoke shave	Graver-Burin	Core tool	Edge-modified flake	Core	Tested cobble	Unmodified flake	Metate	Other ground stone	Hammerstone	Total
61	96.20–96.10	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	–	–	–	8
62	96.00–95.90	5	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	10	–	–	–	10
62	96.00–95.92	5	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
62	96.10–96.00	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	2
62	96.20–96.10	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	7
62	96.30–96.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
62	96.37–96.30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
63	95.70–95.60	3	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
63	95.80–95.70	3	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	–	–	–	7
63	95.90–95.80	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	14	–	–	–	14
63	96.00–95.90	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	29	–	–	–	29
63	96.10–96.00	3	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	1	–	14	–	–	–	16
63	96.20–96.10	3	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	2	–	–	21	–	–	–	24
64	95.80–95.63	4	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	–	–	–	7
64	95.80–95.70	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
64	95.90–95.80	3	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	28	–	–	–	29
64	95.98–95.55	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	64	–	–	–	64
64	96.00–95.90	3	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	46	–	–	–	48
64	96.10–96.00	3	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	37	–	–	–	38
64	96.20–96.10	–	–	2	0	1	–	–	–	–	–	–	–	–	–	–	–	1	–	–	34	–	–	–	38
64	96.24–96.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
65	95.80–95.70	3	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9	–	–	–	9

Table D.1, continued

Test Unit	Elevation (m)	Feature	Other Provenience	Arrow point	Arrow point preform	Dart point	Dart point preform	Perforator	Early- to middle-stage biface	Late-stage to finished biface	Miscellaneous biface	End scraper	Side scraper	Miscellaneous uniface	Spoke shave	Graver-Burin	Core tool	Edge-modified flake	Core	Tested cobble	Unmodified flake	Metate	Other ground stone	Hammerstone	Total
65	95.90–95.80	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13	–	–	–	13
65	96.00–95.90	3	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	35	–	–	–	36
65	96.10–96.00	3	–	1	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	51	–	–	–	54
65	96.20–96.10	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	1	–	–	31	–	–	–	33
66	96.00–95.90	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
66	96.10–96.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	19	–	–	–	19
66	96.20–96.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	11	–	–	–	11
66	96.27–96.20	–	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	18	–	–	–	20
67	95.70–95.60	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
67	96.00–95.90	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
67	96.22–96.10	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8	–	–	–	8
68	95.80–95.70	–	flotation sample	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
68	95.90–95.80	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9	–	–	–	9
68	96.00–95.90	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	14	–	–	–	14
68	96.10–96.00	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	59	–	–	–	59
68	96.20–96.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	5
68	96.24–96.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
69	95.90–95.80	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
69	96.00–95.90	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
69	96.10–96.00	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	15	–	–	–	16
69	96.20–96.10	–	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	1	–	–	23	–	–	–	26
69	96.27–96.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	4
70	96.00–95.90	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	4	–	–	–	5
70	96.10–96.00	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
70	96.20–96.10	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
71	95.60–95.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
71	95.80–95.70	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1

Table D.1, continued

Test Unit	Elevation (m)	Feature	Other Provenience	Arrow point	Arrow point preform	Dart point	Dart point preform	Perforator	Early- to middle-stage biface	Late-stage to finished biface	Miscellaneous biface	End scraper	Side scraper	Miscellaneous uniface	Spoke shave	Graver-Burin	Core tool	Edge-modified flake	Core	Tested cobble	Unmodified flake	Metate	Other ground stone	Hammerstone	Total
71	95.90–95.80	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
71	96.00–95.90	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	3
71	96.10–96.00	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	5
71	96.18–96.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2
Area 3 Subtotal				4	0	10	1	1	11	4	0	1	0	1	1	0	1	16	2	0	1,140	0	0	0	1,193
Total				4	1	25	1	1	21	11	1	2	1	4	2	3	2	39	17	1	3,253	2	2	1	3,394

* These were originally designated as Feature 7, but this designation was dropped.

APPENDIX E: Summary of Archeological Data for Paluxy Sites on Fort Hood

Between 1991 and 1993, Mariah Associates, Inc., geoarcheologists first recognized Paluxy sites as a distinct class of archeological site on Fort Hood. Since then, 37 sites have been classified as Paluxy localities and evaluated for National Register eligibility. The list of Paluxy sites on Fort Hood appears in Table E.1.

The tabulated data presented herein summarize the archeological testing and attributes of all of the known Paluxy sites on Fort Hood (Table E.2.). The information pertains to each investigation that involved shovel testing, limited testing with hand-excavated units, or data recovery investigations. Information from the initial survey or site recording is excluded. There is one column of information for each investigation, and some sites have two or more columns of data from different phases of work.

Most of the data were initially compiled and presented as Tables A, B, and C in *Planning Document for Treatment of National Register-Eligible Prehistoric Sites under Section 106 of the National Historic Preservation Act, Fort Hood, Texas*, by Douglas K. Boyd, Gemma Mehalchick, and Ann M. Scott, Cultural Resources Management Program, Environmental Division, Department of Public Works, United States Army Fort Hood (2000). Further information has been added to update the site data through January 2002.

Excluding those that are self explanatory, the following abbreviations or designations are used in this appendix:

Subarea: Formally designated subareas are designated by capital letters (A, B, or C) and have been presented as such in previous publications.

Investigator: Only two firms have done work on Paluxy sites at Fort Hood, but three abbreviations are used.

Mariah = Mariah Associates, Inc. (Austin, Texas)
TRC-M = TRC Mariah Associates, Inc. (Austin, Texas; formerly Mariah Associates, Inc.)
PAI = Prewitt and Associates, Inc. (Austin, Texas)

Reference: RR refers to a Research Report in the Fort Hood Archeological Resource Management Series.

Test Units: All excavations are 50x50 cm or larger, and they are usually 1x1 m in size. TP refers to Test Pits, the term Mariah and TRC-Mariah used.

Shovel Tests: Square or circular excavations ca. 30 cm in size or diameter.

Square Meters Hand Excavated: Total area of all hand excavations (excluding shovel tests).

Cubic Meters Hand Excavated: Total volume of all hand excavations (excluding shovel tests).

Depth of Cultural Deposits: The maximum depth of the cultural deposits encountered at the site.

U = unknown (depth of deposits not clearly stated in reports or site records or not known because testing is limited)

Thickness of Cultural Deposits: The maximum thickness of all cultural deposits (from shallowest to deepest) encountered at a site.

U = unknown (thickness of deposits not clearly stated in reports or site records or not known because testing is limited)

Discrete Natural Stratigraphy and Discrete Cultural Stratigraphy: Refers to whether or not discrete soil or stratigraphic layers are present.

Y = yes (strata are well defined)
N = no (strata are not well defined)
U = uncertain (information is inadequate to fully assess)

Total Age Span and Component Age:

U = unknown (a component is defined but its age is unknown)
P = Protohistoric
LP = Late Prehistoric
LP-Austin = Austin Phase
LP-Toyah = Toyah Phase
LA = Late Archaic
MA = Middle Archaic
EA = Early Archaic
PALEO = Paleoindian

Number of Radiocarbon Dates: Total radiocarbon dates associated with site or subarea.

Table E.1. Paluxy sites on Fort Hood

Site No.	Subarea	National Register Eligibility
41CV0319	–	Eligible
41CV0478	–	Eligible
41CV0594	–	Eligible
41CV0595	–	Eligible
41CV0946	B	Not Eligible
41CV0947	–	Eligible
41CV0981	–	Not Eligible
41CV0983	–	Not Eligible
41CV0984	–	Eligible
41CV0988	A and B	Not Eligible
41CV0991	–	Not Eligible
41CV0994	–	Not Eligible
41CV1023	A	Eligible
41CV1027	–	Eligible
41CV1027	–	Eligible
41CV1043	A	Eligible
41CV1048	B	Not Eligible
41CV1049	A	Eligible
41CV1050	A	Not Eligible
41CV1093	–	Eligible
41CV1106	–	Eligible
41CV1135	–	Not Eligible
41CV1138	–	Eligible
41CV1141	–	Eligible
41CV1143	A	Eligible
41CV1145	–	Not Eligible
41CV1191	–	Eligible
41CV1194	–	Not Eligible
41CV1227	–	Not Eligible
41CV1229	–	Not Eligible
41CV1239	–	Not Eligible
41CV1258	A, B, and C	Not Eligible
41CV1283	A and B	Not Eligible
41CV1296	–	Not Eligible
41CV1391	A and C	Eligible (C only)
41CV1403	–	Eligible
41CV1415	–	Unknown
41CV1553	–	Eligible

Note: Site 41CV1287-C was originally designated as Paluxy site based on reconnaissance and shovel testing (Trierweiler ed. 1994:Appendix F). Subsequent testing investigations showed that no Paluxy sediments were present (Kleinbach et al. 1999:243–247).

Number of Temporally Diagnostic Artifacts: Total time-diagnostic artifacts associated with the site or subarea. Diagnostics are generally projectile points, but ceramic sherds are also included in the count.

U = uncertain (a report or site records indicate diagnostic specimens were found, but the actual number of specimens is unclear, or it is unclear that specimens from a site are associated with the particular subarea)

Components Defined: number of discrete cultural components identified with some degree of confidence

0 = no components defined or nothing is known about the components

Numbers of Artifacts by Type and Total Number of All Artifacts: The numbers of collected specimens in various artifact classes and the cumulative total of specimens in all artifact categories. These numbers do not include specimens that were observed but not collected.

0 = no artifacts were recovered
U = uncertain (artifacts were recovered but the number of specimens could not be determined)

Artifact Density: calculated as the number of artifacts recovered per number of cubic meters excavated

Generally refers only to artifacts recovered in Test Units, but for some sites this num-ber is skewed because it includes materials recovered in shovel tests, but the volume of excavated shovel test fill is not factored in.

U = uncertain (density could not be calculated because either the number of collected specimens or the total volume of hand excavated units is unclear)

Unmodified Bones and Unmodified Shells:

P = present (observed or collected; may be surface or subsurface)
A = absent (this is assumed if none are mentioned in report and site records)

If limited or no excavations were done, absent does not indicate potential for preservation.

Macrobotanical Remains Observed and Macrobotanical Remains Recovered:

Y = yes
N = no
I = indeterminate (information is not adequate to determine)

Numbers of Features by Type and Total Number of Buried Features: the numbers of features observed in each category and the number of features wholly or partially buried

Surface features without evidence that they are partially buried are excluded. All mounds and middens are assumed to be at least partially buried and are included as "Buried Features." Note that "internal hearths" are discrete features found within mounds and middens (includes remnants of earth ovens).

Number of Features with Charred Remains: the number of features where charred organic remains suitable for radiocarbon dating and botanical analyses were observed or recovered

Number of Features with Abundant Charred Remains: the number of features where an unusually high quantity of charred organic remains suitable for radiocarbon dating and botanical analyses were observed or recovered

The abundance is in relation to remains observed in features within the same site type only (i.e., Paluxy sites are not compared with other site classes).

Number of Radiocarbon Dated Features: the number of features that have yielded associated organic remains that were radiocarbon dated

Table E.2. Summary of archeological data from investigations of Paluxy sites on Fort Hood

Site	41CV0319		41CV0478		41CV0594	
Subarea	--	--	A	A	--	--
Investigator and Year of Fieldwork	Mariah in 1992	Mariah in 1993	Mariah in 1992	TRC-M in 1995	Mariah in 1992-1993	Mariah in 1993
Type of Investigation	Reconnaissance and shovel testing	NRHP testing	Reconnaissance and shovel testing	NRHP testing	Reconnaissance and shovel testing	Testing
National Register Assessment	Unknown	Eligible	Unknown	Eligible	Unknown	Eligible
Reference	RR 31:A807-A808	RR 34:450-459	RR 31:A913-A915	RR 35:338-345	RR 31:A961-A964	RR 31:230-233, 258-260
# of Test Units (or TPs) Excavated	0	4	0	4	0	2
# of Shovel Tests Excavated	6	0	12	0	2	0
# of Backhoe Trenches Excavated		1		0		1
# of Square Meters Hand Excavated		4		4		3
# of Cubic Meters Hand Excavated		2.6		2.7		1.55
Depth of Cultural Deposits (cm)		110		90		80
Thickness of Cultural Deposits (cm)		110		20-30		55
Discrete Natural Stratigraphy (Y/N/U)		Y		Y		Y
Discrete Cultural Stratigraphy (Y/N/U)		Y		Y		Y
Total Age Span (Periods; Date)		LP		MA		LP; LA; MA
# of Radiocarbon Dates		1		3		4
# of Temporally Diagnostic Artifacts		0		0		7
# of Components Defined		1		1		3
Component 1 Age		LP		MA		LP
Component 2 Age						LA
Component 3 Age						MA
Component 4 Age						
# of Chipped Stone Artifacts	6	38	10	43	55	43
# of Ground Stone Artifacts	0	0	0	0	0	0
# of Bone and Shell Artifacts	0	0	0	0	0	0
# of Ceramic Sherds	0	0	0	0	0	0
# of Other Artifacts	0	0	0	0	0	0
Total # of All Artifacts	6	38	10	43	55	43
Artifact Density (# Artifacts per M3)		14.62		15.93		27.74
Unmodified Bones (P/A)	A	A	A	P		A
Unmodified Mussel Shells (P/A)	A	A	A	P		P
Macrobotanical Remains Observed (Y/N/I)		Y		N		I
Macrobotanical Remains Recovered (Y/N/I)		N		N		Y
# of Mounds	1					3
# of Middens		1				
# of Internal Hearths (in a mound or midden)						
# of Earth Ovens						
# of Hearths				2		
# of BR Clusters						
# of BR Scatters						
# of BR Concentrations	1	1				1
# of Ash Concentrations						
# of Living Surfaces/Occupation Zones						
# of Miscellaneous Features						
# of Shell Middens						
# of Human Burials						
Total # of Buried Features	1	2		2		4
# of Features w/Any Charred Remains						1
# of Features w/Abundant Charred Remains		1				
# of Radiocarbon Dated Features		1		2		1

Table E.2., continued

Site	41CV595 (Firebreak site)			41CV946	41CV0947	
Subarea	--	--	--	B	--	--
Investigator and Year of Fieldwork	Mariah in 1992	Mariah in 1993	PAI in 2000	Mariah in 1992	Mariah in 1992	PAI in 1996
Type of Investigation	Reconnaissance and shovel testing	NRHP testing	Data Recovery	Reconnaissance and shovel testing	Reconnaissance and shovel testing	NRHP testing
National Register Assessment	Unknown	Eligible	Eligible	Not Eligible	Unknown	Eligible
Reference	RR 31:A965-A968	RR 34:472-283	this report	RR 31:A1105-A1106	RR 31:A1107-A1109	RR 38:59-65
# of Test Units (or TPs) Excavated	0	4	67	0	0	3
# of Shovel Tests Excavated	13	0	0	16	20	0
# of Backhoe Trenches Excavated		4	9			1
# of Square Meters Hand Excavated		4	67			3
# of Cubic Meters Hand Excavated		3.5	35.7			3.1
Depth of Cultural Deposits (cm)		150	110			90
Thickness of Cultural Deposits (cm)		140	110			80
Discrete Natural Stratigraphy (Y/N/U)		Y	N	N	U	Y
Discrete Cultural Stratigraphy (Y/N/U)		Y	N	N	U	Y
Total Age Span (Periods; Date)		LP; LA	LP; LA	U	U	LA
# of Radiocarbon Dates		3	12	0	LP; LA	2
# of Temporally Diagnostic Artifacts		4	28	1	2	1
# of Components Defined		2	2	1		1
Component 1 Age		LP	LP	LA		LA
Component 2 Age		LA	LA			
Component 3 Age						
Component 4 Age						
# of Chipped Stone Artifacts	55	490	3390	9	46	148
# of Ground Stone Artifacts	0	0	4	0	0	0
# of Bone and Shell Artifacts	0	0	0	0	0	0
# of Ceramic Sherds	0	0	0	0	0	0
# of Other Artifacts	0	0	0	0	0	0
Total # of All Artifacts	55	490	3394	9	46	148
Artifact Density (# Artifacts per M3)		140.00	95.07			47.74
Unmodified Bones (P/A)	P	P	P	A	A	A
Unmodified Mussel Shells (P/A)	P	A	P	A	P	P
Macrobotanical Remains Observed (Y/N/I)		Y	Y	N		Y
Macrobotanical Remains Recovered (Y/N/I)		N	Y	N		Y
# of Mounds			1			
# of Middens		2	2		1	
# of Internal Hearths (in a mound or midden)			1			
# of Earth Ovens			3			
# of Hearths			3			1
# of BR Clusters			1			
# of BR Scatters						
# of BR Concentrations			3	1		
# of Ash Concentrations						
# of Living Surfaces/Occupation Zones			1			2
# of Miscellaneous Features			1			
# of Shell Middens						
# of Human Burials						
Total # of Buried Features		2	15		1	3
# of Features w/Any Charred Remains		1	9			2
# of Features w/Abundant Charred Remains			3			
# of Radiocarbon Dated Features		2	7			2

Table E.2., continued

Site	41CV981	41CV983	41CV0984		41CV0988		
Subarea	--	--	--	--	--	--	A, B
Investigator and Year of Fieldwork	Mariah in 1992	Mariah in 1992	Mariah in 1992	PAI in 1996	Mariah in 1992	PAI in 1996	PAI in 2000
Type of Investigation	Reconnaissance and shovel testing	Reconnaissance and shovel testing	Reconnaissance and shovel testing	NRHP testing	Reconnaissance and shovel testing	NRHP testing	Reassessment and Testing
National Register Assessment	Not Eligible	Not Eligible	Unknown	Eligible	Unknown	Eligible	Not Eligible
Reference	RR 31:A1128	RR 31:A1129	RR 31:A1130-A1132	RR 38:65-71	RR 31:A1133-A1135	RR 38:71-79	this report
# of Test Units (or TPs) Excavated	0	0	0	5	0	8	10
# of Shovel Tests Excavated	10	0	7	0	15	0	0
# of Backhoe Trenches Excavated				0		0	4
# of Square Meters Hand Excavated				5		8.5	10
# of Cubic Meters Hand Excavated				2.6		3.75	6.9
Depth of Cultural Deposits (cm)				60		43	100
Thickness of Cultural Deposits (cm)				60		35	100
Discrete Natural Stratigraphy (Y/N/U)				Y		Y	N
Discrete Cultural Stratigraphy (Y/N/U)				U		U	N
Total Age Span (Periods; Date)				LA		LA	LA
# of Radiocarbon Dates				2		2	0
# of Temporally Diagnostic Artifacts				2		5	6
# of Components Defined				1		1	1
Component 1 Age				LA		LA	LA
Component 2 Age							
Component 3 Age							
Component 4 Age							
# of Chipped Stone Artifacts	0	0	5	415	14	544	156
# of Ground Stone Artifacts	0	0	0	0	0	1	0
# of Bone and Shell Artifacts	0	0	0	0	0	0	0
# of Ceramic Sherds	0	0	0	0	0	0	0
# of Other Artifacts	0	0	0	0	0	0	0
Total # of All Artifacts	0	0	5	415	14	545	156
Artifact Density (# Artifacts per M3)				159.62		145.33	22.61
Unmodified Bones (P/A)	A	A	A	A		P	A
Unmodified Mussel Shells (P/A)	A	A	A	A		A	P
Macrobotanical Remains Observed (Y/N/I)				Y		Y	N
Macrobotanical Remains Recovered (Y/N/I)				Y		Y	N
# of Mounds			2	2			
# of Middens							
# of Internal Hearths (in a mound or midden)							
# of Earth Ovens							
# of Hearths						2	1
# of BR Clusters							
# of BR Scatters		1	1		1	1	
# of BR Concentrations	3				2	1	
# of Ash Concentrations							
# of Living Surfaces/Occupation Zones							
# of Miscellaneous Features							
# of Shell Middens							
# of Human Burials							
Total # of Buried Features			2	2		4	1
# of Features w/Any Charred Remains				1		2	
# of Features w/Abundant Charred Remains							
# of Radiocarbon Dated Features				1		2	

Table E.2., continued

Site	41CV991	41CV994	41CV1023		41CV1027		
Subarea	--	A	A	A	--		--
Investigator and Year of Fieldwork	Mariah in 1992	Mariah in 1992	Mariah in 1992	Mariah in 1993	Mariah in 1992	Mariah in 1993	Mariah in 1992-1993
Type of Investigation	Reconnaissance and shovel testing	Reconnaissance and shovel testing	Reconnaissance and shovel testing	NRHP testing	Reconnaissance and shovel testing	Testing	NRHP testing
National Register Assessment	Not Eligible	Not Eligible	Unknown	Eligible	Unknown	Unknown	Eligible
Reference	RR 31:A1136	RR 31:A1137-A1138	RR 31:A1164-A1167	RR 34:532-543	RR 31:A1172-A1173	RR 31:233-237, 260	RR 34:543-551
# of Test Units (or TPs) Excavated	0	0	0	5	0	2	8
# of Shovel Tests Excavated	1	4	18	0	19	0	0
# of Backhoe Trenches Excavated				0		1	1
# of Square Meters Hand Excavated				5			8.5
# of Cubic Meters Hand Excavated				1.59			5.5
Depth of Cultural Deposits (cm)				20			100
Thickness of Cultural Deposits (cm)				20			100
Discrete Natural Stratigraphy (Y/N/U)				U			Y
Discrete Cultural Stratigraphy (Y/N/U)				Y			Y
Total Age Span (Periods; Date)				LP	A		LP; MA
# of Radiocarbon Dates				0		4	4
# of Temporally Diagnostic Artifacts				3	1	1	2
# of Components Defined				1		1	2
Component 1 Age				LP		MA	LP
Component 2 Age							MA
Component 3 Age							
Component 4 Age							
# of Chipped Stone Artifacts	0	0	19	219	4	101	118
# of Ground Stone Artifacts	0	0	0	0	0	0	0
# of Bone and Shell Artifacts	0	0	0	0	0	0	0
# of Ceramic Sherds	0	0	0	0	0	0	0
# of Other Artifacts	0	0	0	0	0	0	0
Total # of All Artifacts	0	0	19	219	4	101	118
Artifact Density (# Artifacts per M3)				137.74			21.45
Unmodified Bones (P/A)				A		A	A
Unmodified Mussel Shells (P/A)				A		P	P
Macrobotanical Remains Observed (Y/N/I)				N		Y	Y
Macrobotanical Remains Recovered (Y/N/I)				N		Y	Y
# of Mounds						1	1
# of Middens							1
# of Internal Hearths (in a mound or midden)							
# of Earth Ovens							
# of Hearths							1
# of BR Clusters							
# of BR Scatters	2						
# of BR Concentrations		2		4			1
# of Ash Concentrations							
# of Living Surfaces/Occupation Zones							
# of Miscellaneous Features							
# of Shell Middens							
# of Human Burials							
Total # of Buried Features				4		1	4
# of Features w/Any Charred Remains						1	1
# of Features w/Abundant Charred Remains							
# of Radiocarbon Dated Features						1	1

Table E.2., continued

Site	41CV1043		41CV1048	41CV1049		41CV1050	
Subarea	A	A	B	A	A	A	A
Investigator and Year of Fieldwork	Mariah in 1992	PAI in 1996	Mariah in 1992	Mariah in 1992	PAI in 1996	Mariah in 1992	PAI in 1996
Type of Investigation	Reconnaissance and shovel testing	NRHP testing	Reconnaissance and shovel testing	Reconnaissance and shovel testing	NRHP testing	Reconnaissance and shovel testing	NRHP testing
National Register Assessment	Unknown	Not Eligible	Not Eligible	Unknown	Eligible	Unknown	Not Eligible
Reference	RR 31: A1191-A1193	RR 38:79-83	RR 31: A1194-A1197	RR 31:A1198-A1200	RR 38:83-90	RR 31: A1201-A1203	RR 38:90-94
# of Test Units (or TPs) Excavated	0	6	0	0	4	0	4
# of Shovel Tests Excavated	5	0	23	14	0	17	0
# of Backhoe Trenches Excavated		0			3		3
# of Square Meters Hand Excavated		6			4		4
# of Cubic Meters Hand Excavated		3			3.3		1.5
Depth of Cultural Deposits (cm)		50			80		30
Thickness of Cultural Deposits (cm)		50			80		30
Discrete Natural Stratigraphy (Y/N/U)		Y			Y		N
Discrete Cultural Stratigraphy (Y/N/U)		N			N		N
Total Age Span (Periods; Date)		LP: LA	LA	LA	LP; LA	LA	LA
# of Radiocarbon Dates		0			2		0
# of Temporally Diagnostic Artifacts		1	1	1	3	1	2
# of Components Defined		0			2		0
Component 1 Age					LP		
Component 2 Age					LA		
Component 3 Age							
Component 4 Age							
# of Chipped Stone Artifacts	3	61	2	11	108	19	29
# of Ground Stone Artifacts	0	1	0	0	0	0	0
# of Bone and Shell Artifacts	0	0	0	0	0	0	0
# of Ceramic Sherds	0	0	0	0	0	0	0
# of Other Artifacts	0	0	0	0	0	0	0
Total # of All Artifacts	3	62	2	11	108	19	29
Artifact Density (# Artifacts per M3)		20.67			32.73		19.33
Unmodified Bones (P/A)		A			P		A
Unmodified Mussel Shells (P/A)		A			A		A
Macrobotanical Remains Observed (Y/N/I)		Y			Y		N
Macrobotanical Remains Recovered (Y/N/I)		Y			Y		N
# of Mounds	1	1					
# of Middens				2			
# of Internal Hearths (in a mound or midden)							
# of Earth Ovens							
# of Hearths				1	2		
# of BR Clusters							
# of BR Scatters							
# of BR Concentrations	2	3		2		3	
# of Ash Concentrations							
# of Living Surfaces/Occupation Zones							
# of Miscellaneous Features							
# of Shell Middens							
# of Human Burials							
Total # of Buried Features	1	1		2	2		
# of Features w/Any Charred Remains		1			2		
# of Features w/Abundant Charred Remains							
# of Radiocarbon Dated Features					2		

Table E.2., continued

Site	41CV1093		41CV1106		41CV1135	41CV1138	
Subarea	--	--	--	--	--	--	--
Investigator and Year of Fieldwork	Mariah in 1992	PAI in 1996	Mariah in 1992	PAI in 1996	Mariah in 1992	Mariah in 1993	PAI in 1996
Type of Investigation	Reconnaissance and shovel testing	NRHP testing	Reconnaissance and shovel testing	NRHP testing	Reconnaissance and shovel testing	Reconnaissance and shovel testing	NRHP testing
National Register Assessment	Unknown	Eligible	Unknown	Eligible	Not Eligible	Unknown	Eligible
Reference	RR 31: A1219-A1222	RR 38:94-100	RR 31: A1242-A1244	RR 38:100-104	RR 31: A1269-A1270	RR 31: A1277-A1279	RR 38:104-111
# of Test Units (or TPs) Excavated	0	5	0	7	0	0	5
# of Shovel Tests Excavated	13	0	7	0	33	54	0
# of Backhoe Trenches Excavated		1		0			2
# of Square Meters Hand Excavated		5		7			5
# of Cubic Meters Hand Excavated		2.5		3.1			3.8
Depth of Cultural Deposits (cm)		70		63			140
Thickness of Cultural Deposits (cm)		70		25			10
Discrete Natural Stratigraphy (Y/N/U)		Y		Y			Y
Discrete Cultural Stratigraphy (Y/N/U)		U		Y			Y
Total Age Span (Periods; Date)	LA	LA	U	LP; LA	LA	LA	LA
# of Radiocarbon Dates	1	1		1			1
# of Temporally Diagnostic Artifacts		1		2	1	3	4
# of Components Defined		1		2			1
Component 1 Age		LA		LP			LA
Component 2 Age				LA			
Component 3 Age							
Component 4 Age							
# of Chipped Stone Artifacts	34	249	15	37	7	15	140
# of Ground Stone Artifacts	0	1	0	0	0	0	0
# of Bone and Shell Artifacts	0	0	0	0	0	0	0
# of Ceramic Sherds	0	0	0	0	0	0	0
# of Other Artifacts	0	1	0	0	0	0	0
Total # of All Artifacts	34	251	15	37	7	15	140
Artifact Density (# Artifacts per M3)		100.40		11.94			36.84
Unmodified Bones (P/A)		A		A			A
Unmodified Mussel Shells (P/A)		A		A			A
Macrobotanical Remains Observed (Y/N/I)		Y		Y			Y
Macrobotanical Remains Recovered (Y/N/I)		Y		Y			Y
# of Mounds		1					
# of Middens							
# of Internal Hearths (in a mound or midden)							
# of Earth Ovens							
# of Hearths							1
# of BR Clusters							
# of BR Scatters							
# of BR Concentrations	7	2	3	2	4	12	1
# of Ash Concentrations							
# of Living Surfaces/Occupation Zones				1			
# of Miscellaneous Features							
# of Shell Middens							
# of Human Burials							
Total # of Buried Features		3		3			2
# of Features w/Any Charred Remains		1		1			1
# of Features w/Abundant Charred Remains		1					1
# of Radiocarbon Dated Features		1		1			1

Table E.2., continued

Site	41CV1141		41CV1143		41CV1145	41CV1191	
Subarea	--	--	A	A	--	--	--
Investigator and Year of Fieldwork	Mariah in 1993	PAI in 2000	Mariah in 1992	PAI in 1996	Mariah in 1992	Mariah in 1992	PAI in 1996
Type of Investigation	Testing	Reassessment and Testing	Reconnaissance and shovel testing	NRHP testing	Reconnaissance and shovel testing	Reconnaissance and shovel testing	NRHP testing
National Register Assessment	Eligible	Eligible	Unknown	Eligible	Not Eligible	Unknown	Eligible
Reference	RR 31:A1280-A1284	this report	RR 31: A1285-A1287	RR 38:111-115	RR 31: A1288	RR 31: A1335-A1337	RR 38:116-124
# of Test Units (or TPs) Excavated	1	12	0	3	0	0	2
# of Shovel Tests Excavated	30	0	4	0	0	11	0
# of Backhoe Trenches Excavated	0	13		0			0
# of Square Meters Hand Excavated	1	12		3			2
# of Cubic Meters Hand Excavated	0.3	5.75		2.3			1
Depth of Cultural Deposits (cm)	30	70		43			40-50
Thickness of Cultural Deposits (cm)	30	70		20			20
Discrete Natural Stratigraphy (Y/N/U)	Y	N		Y			Y
Discrete Cultural Stratigraphy (Y/N/U)	U	N		Y			U
Total Age Span (Periods; Date)	LA			LP; LA			U
# of Radiocarbon Dates	0			2			0
# of Temporally Diagnostic Artifacts	2			1			0
# of Components Defined	1			2			1
Component 1 Age	LA			LP			U
Component 2 Age				LA			
Component 3 Age							
Component 4 Age							
# of Chipped Stone Artifacts	125	521	1	3	0	42	1
# of Ground Stone Artifacts	0	0	0	0	0	0	0
# of Bone and Shell Artifacts	0	0	0	0	0	0	0
# of Ceramic Sherds	0	0	0	0	0	0	0
# of Other Artifacts	0	0	0	0	0	0	0
Total # of All Artifacts	125	521	1	3	0	42	1
Artifact Density (# Artifacts per M3)	246.67	246.67		1.30			1.00
Unmodified Bones (P/A)	A	P		A			A
Unmodified Mussel Shells (P/A)	A	P		P			A
Macrobotanical Remains Observed (Y/N/I)	Y	Y		Y			N
Macrobotanical Remains Recovered (Y/N/I)	I	Y		N			Y
# of Mounds						1	
# of Middens	1	3					
# of Internal Hearths (in a mound or midden)							
# of Earth Ovens							
# of Hearths	1	2		1			
# of BR Clusters							
# of BR Scatters					1		
# of BR Concentrations	1	1	4	1	1		1
# of Ash Concentrations							
# of Living Surfaces/Occupation Zones		1					
# of Miscellaneous Features		1					
# of Shell Middens							
# of Human Burials							
Total # of Buried Features	3	8		2		1	1
# of Features w/Any Charred Remains		7		2			1
# of Features w/Abundant Charred Remains	2						
# of Radiocarbon Dated Features				2			

Table E.2., continued

Site	41CV1194		41CV1227	41CV1229	41CV1239	41CV1258	
Subarea	--	--	--	--	--	A, B, C	B
Investigator and Year of Fieldwork	Mariah in 1992	PAI in 1996	Mariah in 1992	Mariah in 1992	Mariah in 1992-1993	Mariah in 1992	PAI in 1996
Type of Investigation	Reconnaissance and shovel testing	NRHP testing	Reconnaissance and shovel testing	Reconnaissance and shovel testing	Reconnaissance and shovel testing	Reconnaissance and shovel testing	NRHP testing
National Register Assessment	Unknown	Not Eligible	Not Eligible	Not Eligible	Not Eligible	&C=Not Eligible B=Unknov	Not Eligible
Reference	RR 31: A1338-A1340	RR 38:124-127	RR 31: A1368	RR 31: A1369	RR 31: A1378	RR 31: A1397-A1399	RR 38:127-133
# of Test Units (or TPs) Excavated	0	1	0	0	0	0	6
# of Shovel Tests Excavated	3	0	5	0	51	44	0
# of Backhoe Trenches Excavated		0					1
# of Square Meters Hand Excavated		1					6
# of Cubic Meters Hand Excavated		0.3					5.3
Depth of Cultural Deposits (cm)		30					80
Thickness of Cultural Deposits (cm)		30					40
Discrete Natural Stratigraphy (Y/N/U)		N					Y
Discrete Cultural Stratigraphy (Y/N/U)		N					Y
Total Age Span (Periods; Date)		U				LA	N
# of Radiocarbon Dates		0					LA
# of Temporally Diagnostic Artifacts		0				1	1
# of Components Defined		0					0
Component 1 Age							1
Component 2 Age							LA
Component 3 Age							
Component 4 Age							
# of Chipped Stone Artifacts	6	12	0	0	0	2	9
# of Ground Stone Artifacts	0	0	0	0	0	0	0
# of Bone and Shell Artifacts	0	0	0	0	0	0	0
# of Ceramic Sherds	0	0	0	0	0	0	0
# of Other Artifacts	0	0	0	0	0	0	0
Total # of All Artifacts	6	12	0	0	0	2	9
Artifact Density (# Artifacts per M3)		40.00					1.70
Unmodified Bones (P/A)		A					A
Unmodified Mussel Shells (P/A)		A					A
Macrobotanical Remains Observed (Y/N/I)		Y					Y
Macrobotanical Remains Recovered (Y/N/I)		Y					Y
# of Mounds							
# of Middens		1					
# of Internal Hearths (in a mound or midden)							
# of Earth Ovens							
# of Hearths							1
# of BR Clusters							
# of BR Scatters				5			
# of BR Concentrations	1		?		2	3	2
# of Ash Concentrations							
# of Living Surfaces/Occupation Zones							
# of Miscellaneous Features							
# of Shell Middens							1
# of Human Burials							
Total # of Buried Features		1					1
# of Features w/Any Charred Remains		1					1
# of Features w/Abundant Charred Remains							
# of Radiocarbon Dated Features							1

Table E.2., continued

Site	41CV1283		41CV1296	41CV1391		41CV1403
Subarea	A and B	B	--	A	C	--
Investigator and Year of Fieldwork	Mariah in 1992	PAI in 1996	Mariah in 1992	Mariah in 1992	Mariah in 1993	TRC-Mariah in 1994
Type of Investigation	Reconnaissance and shovel testing	NRHP testing	Reconnaissance and shovel testing	Reconnaissance and shovel testing	NRHP testing	NRHP testing
National Register Assessment	Not Eligible	Not Eligible	Not Eligible	Not Eligible	Eligible	Eligible
Reference	RR 31:A1424-A1426	RR 38:133-137	RR 31: A1438	RR 31: A1517-A1519	RR 34:642-652	RR 35:478-485
# of Test Units (or TPs) Excavated	0	2	0	0	5	2
# of Shovel Tests Excavated	14	0	0	3	0	0
# of Backhoe Trenches Excavated		0			0	4
# of Square Meters Hand Excavated		2			5	2
# of Cubic Meters Hand Excavated		0.8			2.8	0.8
Depth of Cultural Deposits (cm)		30			60	50
Thickness of Cultural Deposits (cm)		20			50	50
Discrete Natural Stratigraphy (Y/N/U)		Y			Y	Y
Discrete Cultural Stratigraphy (Y/N/U)		N			Y	Y
Total Age Span (Periods; Date)	LA	U			LP; LA	LA; MA
# of Radiocarbon Dates		0			2	2
# of Temporally Diagnostic Artifacts	4	0			2	1
# of Components Defined		0			2	2
Component 1 Age					LP	LA
Component 2 Age					LA	MA
Component 3 Age						
Component 4 Age						
# of Chipped Stone Artifacts	23	129	0	0	240	95
# of Ground Stone Artifacts	0	0	0	0	0	0
# of Bone and Shell Artifacts	0	0	0	0	0	0
# of Ceramic Sherds	0	0	0	0	0	0
# of Other Artifacts	0	0	0	0	0	0
Total # of All Artifacts	23	129	0	0	240	95
Artifact Density (# Artifacts per M3)		161.25			85.71	118.75
Unmodified Bones (P/A)		A			A	A
Unmodified Mussel Shells (P/A)		A			A	P
Macrobotanical Remains Observed (Y/N/I)		N			Y	N
Macrobotanical Remains Recovered (Y/N/I)		N			I	N
# of Mounds			1			2
# of Middens	1	1			1	
# of Internal Hearths (in a mound or midden)					1	
# of Earth Ovens						
# of Hearths	1	2				
# of BR Clusters						
# of BR Scatters	3					
# of BR Concentrations	2			1		1
# of Ash Concentrations						
# of Living Surfaces/Occupation Zones						
# of Miscellaneous Features						
# of Shell Middens						
# of Human Burials						
Total # of Buried Features	1	1	1		2	3
# of Features w/Any Charred Remains						
# of Features w/Abundant Charred Remains					2	
# of Radiocarbon Dated Features					1	1

Table E.2., continued

Site	41CV1415	41CV1553		Total
Subarea	--	--	--	
Investigator and Year of Fieldwork	PAI in 1999	Mariah in 1993	PAI in 1999	
Type of Investigation	Reconnaissance and shovel testing	Testing	NRHP testing	
National Register Assessment	Unknown	Not Eligible	Eligible	
Reference	RR 44:159-162 (draft)	RR 31:A1571-A1572	RR 44:281-295 (draft)	
# of Test Units (or TPs) Excavated	0	0	6	193
# of Shovel Tests Excavated	8	23	0	499
# of Backhoe Trenches Excavated		0	8	57
# of Square Meters Hand Excavated		0	6.5	193.5
# of Cubic Meters Hand Excavated		--	3.37	109.41
Depth of Cultural Deposits (cm)	80	U	70	
Thickness of Cultural Deposits (cm)	80		70	
Discrete Natural Stratigraphy (Y/N/U)			Y	
Discrete Cultural Stratigraphy (Y/N/U)			Y	
Total Age Span (Periods; Date)		U	P; LP; LA	
# of Radiocarbon Dates		0	3	52
# of Temporally Diagnostic Artifacts			2	97
# of Components Defined		0	3	35
Component 1 Age			P	
Component 2 Age			LP-Aus	
Component 3 Age			LA	
Component 4 Age				
# of Chipped Stone Artifacts	1		50	7912
# of Ground Stone Artifacts	0		1	8
# of Bone and Shell Artifacts	0		0	0
# of Ceramic Sherds	0		0	0
# of Other Artifacts	0		1	2
Total # of All Artifacts	1		52	7922
Artifact Density (# Artifacts per M3)			15.43	72.41
Unmodified Bones (P/A)			A	
Unmodified Mussel Shells (P/A)			A	
Macrobotanical Remains Observed (Y/N/I)			Y	
Macrobotanical Remains Recovered (Y/N/I)			Y	
# of Mounds				17
# of Middens				17
# of Internal Hearths (in a mound or midden)				2
# of Earth Ovens				
# of Hearths			3	25
# of BR Clusters			1	2
# of BR Scatters				15
# of BR Concentrations	1			82
# of Ash Concentrations				0
# of Living Surfaces/Occupation Zones			1	6
# of Miscellaneous Features				2
# of Shell Middens				1
# of Human Burials				0
Total # of Buried Features			5	91
# of Features w/Any Charred Remains			5	41
# of Features w/Abundant Charred Remains			4	14
# of Radiocarbon Dated Features			3	33